Energy Research and Development Division
FINAL PROJECT REPORT

# MT SURVEY FOR RESOURCE ASSESSMENT AND ENVIRONMENTAL MITIGATION AT THE GLASS MOUNTAIN KGRA

## APPENDICES A-E

Prepared for: California Energy Commission – Geothermal Resources Development Account
Prepared by: Cumming Geoscience
GSY-USA, Inc.

MARCH 2007
CEC-500-2013-063-APA-E

***Prepared by:***

***Primary Author(s):***
William Cumming

Cumming Geoscience
4728 Shade Tree Lane
Santa Rosa CA 95405-7841

Randall Mackie

GSY-USA, Inc.
2261 Market St.
San Francisco, CA 94114-1600

***Contract Number: GEO-02-007***

***Prepared for:***

**California Energy Commission**
**Geothermal Resources Development Account**

Gail Wiggett
***Project Manager***

Linda Spiegel
***Office Manager***
***Energy Generation Research Office***

Laurie ten Hope
***Deputy Director***
***RESEARCH AND DEVELOPMENT DIVISION***

Robert P. Oglesby
***Executive Director***

**DISCLAIMER**

This report was prepared as the result of work sponsored by the California Energy Commission. It does not necessarily represent the views of the Energy Commission, its employees or the State of California. The Energy Commission, the State of California, its employees, contractors and subcontractors make no warranty, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the California Energy Commission nor has the California Energy Commission passed upon the accuracy or adequacy of the information in this report.

# ACKNOWLEDGEMENTS

The authors are especially grateful to the following individuals who contributed greatly to the success of this project:

Mr. Mitch Stark, Resource Manager of Calpine Corporation, who provided access to the existing data sets, obtained permission for their public release and supported the project both technically and administratively;

Ms. Charlene Wardlow who, as Calpine Corporation's Geothermal Government Affairs and Community Relations Manager, managed and negotiated the particularly complex permitting process for the field work conducted as part of this project;

Dr. Gail Wiggett of the California Energy Commission, who patiently provided valuable encouragement and coaching on the GRDA process;

Dr. Joseph Moore and his team at the Energy and Geoscience Institute at the University of Utah, especially Mr. Steven Clausen and Ms. Emily Jackson, who supported the petrography and geology components of this study;

Mr. Gregg Nordquist who, as Consulting Geophysicist at Unocal Corporation (now Chevron), supported the translation of the Glass Mountain legacy data used in this project from a digital format proprietary to Unocal. In the 1980's and 1990's, Mr. Nordquist, with Mr. Daniel Carrier and Mr. Randy Thompson of Unocal Corporation, completed the proprietary analyses and reports that became the foundation for the Glass Mountain geophysics and petrography interpretation of this study.

# PREFACE

The California Legislature created the Geothermal Resources Development Account (GRDA) and the Geothermal Program in 1980. Funding comes from revenues paid to the United States government by geothermal developers for leases on federal land in California. Under the Geothermal Program, the California Energy Commission has assisted numerous eligible private entities and local jurisdictions in geothermal research, development, demonstration, commercialization, planning, mitigations, and environmental enhancement projects related to geothermal energy. The purpose of the program is to enhance and promote geothermal development in California. For more information on the Geothermal Program, please visit the California Energy Commission's Web site at. http://www.energy.ca.gov/geothermal/index.html

The California Energy Commission Energy Research and Development Division supports public interest energy research and development that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The Energy Research and Development Division conducts public interest research, development, and demonstration (RD&D) projects to benefit California.

The Energy Research and Development Division strives to conduct the most promising public interest energy research by partnering with RD&D entities, including individuals, businesses, utilities, and public or private research institutions.

Energy Research and Development Division funding efforts are focused on the following RD&D program areas:

- Buildings End-Use Energy Efficiency
- Energy Innovations Small Grants
- Energy-Related Environmental Research
- Energy Systems Integration
- Environmentally Preferred Advanced Generation
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Renewable Energy TechnologiesTransportation

*MT Survey for Resource Assessment and Environmental Mitigation in the Glass Mountain KGRA* is the final report for the Geothermal Reserouces Development Account contract number GEO-02-007 conducted by GSY-USA, Inc. The information from this project contributes to Energy Research and Development Division's Renewable Program.

For more information about the Energy Research and Development Division, please visit the California Energy Commission's Web site at www.energy.ca.gov/research/ or contact the Energy Commission at 916-327-1549.

# ABSTRACT

The objectives of this project were to use non-invasive methods to indirectly image the permeable geothermal reservoir geometry and mitigate the drilling costs and environmental impact of future geothermal development at Glass Mountain Known Geothermal Resource Area. This was done by more efficiently focusing exploration wells on the most promising target zones. Significant advances were achieved in three dimensional magnetotelluric imaging, allowing three dimensional imaging to be given greater weight than two dimensional imaging in interpreting the data. Magnetotellurics is a geophysical investigation technique that images the earth's subsurface by measuring natural variations of electric and magnetic fields at the surface. Magnetotelluric resistivity patterns were correlated with detailed data on subsurface temperatures, downhole resistivity logging, patterns of rock alteration zones and water entry zones from wells along geologic cross-sections. This confirmed that reservoir interpretation based on correlating magnetotelluric resistivity with temperature sensitive clay alteration was feasible. The magnetotelluric resistivity maps and cross-sections extended these correlations to undrilled areas, revealing the likely geometry of the geothermal system.

Conceptual models based on the resistivity images indicated that major northeast trending structures and the Medicine Lake Volcano rim structure form permeable zones and reservoir boundaries in the Glass Mountain Known Geothermal Resource Area. Several areas that appear to host a relatively shallow permeable reservoir were identified. The magnetotelluric interpretation also indicated that a significant part of the Medicine Lake Volcano was unlikely to host a developable geothermal resource. Depending on the resource development strategy and supporting studies, follow-up magnetotelluric surveys could be justified. The conceptual resource model derived from this study's integrated interpretation illustrates well-targeting strategies that can be reviewed with respect to engineering and environmental issues. By more efficiently directing well targeting, magnetotelluric resistivity imaging can reduce dry hole costs, as well as focus planning efforts and mitigate the environmental impacts of resource development.

**Keywords:** electromagnetic survey, geothermal exploration, geophysics resistivity, magnetotellurics, petrography, Medicine Lake, Glass Mountain Known Geothermal Resource Area

Please use the following citation for this report:

Cumming, William. (Cumming Geoscience). Mackie, Randall. (GSY-USA, Inc.) 2007. ***MT Survey for Resource Assessment and Environmental Mitigation at the Glass Mountain KGRA.*** California Energy Commission, GRDA Geothermal Resources Development Account. CEC-500-2013-063-APA-E

# TABLE OF CONTENTS

**ACKNOWLEDGEMENTS** ..... **i**

**PREFACE** ..... **ii**

**ABSTRACT** ..... **iii**

**TABLE OF CONTENTS** ..... **iv**

**APPENDIX A: Magnetotelluric (MT) Processing Summary** ..... **A-1**

**APPENDIX B: Analysis of mineralogy and fluid inclusion data from Glass Mountain area temperature boreholes** ..... **B-1**

**APPENDIX C: Summary report on the geology and geochemistry of Glass Mountain Geothermal Reservoir, Glass Mountain KGRA, California** ..... **C-1**

**APPENDIX D: Hydrothermal alteration and well lithologies for Glass Mountain wells GMF68-8, GMF31-17 and GMF17A-6, Glass Mountain, CA** ..... **D-1**

**APPENDIX E: MT Survey, Glass Mountain Prospect: Prepared for UNOCAL Geothermal E-1**

# APPENDIX A:
# Magnetotelluric (MT) Processing Summary

The MT processing summary, Table A1, includes the following information.

The MT station labels are those used in the maps in this report. Table 1 of the report indicates the labels used in other reports.

The locations of the stations are in UTM coordinates using the NAD27 datum as requested by Calpine Corporation.

The processing notes indicate the general quality of the station and also provide more specialized descriptions that may help an experienced MT practitioner evaluate the data.

The static mode split indicates any parallel offset at high frequency, usually from about 30 to 300 Hz, between the MT apparent resistivity modes. This is estimated using the principal axes rotation, usually resulting in a maximum estimate. The static mode split is estimated as the ratio of the high to the low apparent resistivities in the two modes and so it is always greater than 1. A higher number indicates a greater potential for static distortion of the MT inversion. With appropriate attention, inversion smoothing often is able to resolve the static in a reasonable way when other MT stations are located nearby. The static mode split is small for most stations in this survey, generally ranging from a ratio of 1 to 2.

**Table A1: MT Station Locations, Processing Summary and Static Mode Split $Rho_{max}/Rho_{min}$**

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| 01 | 618.405 | 4602.209 | 2062 | MT usable. Noisy Phi but seems OK with smoothing. Discontinuities at band edges. Masked few points. 2D split at >200 hz. TEM 1-05 fits Rhomax. Very little static. | 1.15 |
| 02 | 619.355 | 4602.164 | 2048 | OK. 3D split at mid-frequency. TEM 077 >3x higher than Rhomax. TEM 3-03 is 2.3x higher and more conformable. Resistivity unusually low but no static split so left without correction initially.. | 1.00 |
| 03 | 620.973 | 4602.345 | 2092 | MT probably usable. Large Rho discontinuity between bands near 4 Hz. Mask 3 points. TEM S22 implies 2.22x static. However, no static split and station looks like similar resistivity to MT 02. | 1.00 |
| 04 | 621.974 | 4602.084 | 2083 | MT probably usable. Noisy 0.2 to 1 Hz and>80 Hz and so masked. Phase noisy but smoothing seems to work. Small static so moved Rhomin to Rhomax. | 1.68 |
| 05 | 621.427 | 4601.550 | 2020 | MT doubtful because resistivity seems too low. Noisy near 1 Hz and very large Rho discontinuity at band edge. Very small static. TEM 5-16 is close but only nearly conformable. 5-15 suggests there is no static. Unrealistically low 1D resistivity. | 1.00 |
| 06 | 620.115 | 4601.097 | 1966 | OK. Masked 2 points at low frequency. No static split. TEM 5-11 is slightly lower and almost conformable. TEM 2-10 is even closer and conformable. | 1.00 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| 07 | 622.246 | 4599.744 | 1940 | Very good. Two points masked from 5 to 10 Hz. TEM S24 is almost conformable and is between Rhomax and Rhomin. | 2.33 |
| 08 | 624.123 | 4601.102 | 1880 | MT probably OK. Phi noise severe at >1 Hz. Smoothing OK so masked only two points. TEM 4-18 is not conformable at greater depths where it is higher than Rhomax so raised Rhomin only up to Rhomax. | 1.48 |
| 09 | 618.717 | 4601.504 | 2073 | MT probably usable. Very large static. Noisy in Rho and especially Phi but smoothed curves look usable. Masked few points. TEM 1-08 is conformable and between modes, closer to Rhomax. Rhomin becomes max from 0.1 to 4 Hz, which looks like possible noise bias on one mode. | 5.75 |
| 10 | 623.178 | 4602.166 | 2070 | MT probably usable but very noisy near 1 Hz. Noisy phase at >1 Hz. Masked 5 points 0.1 to 5 Hz. Very small static. TEM 4-13 is on trend shallower but is too high at depth. | 1.00 |
| 11 | 622.816 | 4603.024 | 2121 | MT probably usable. Noise from 0.3 to 5 Hz with Rho bias to lower rho. Mask alternate points. TEM 4-10 is conformable and between modes closer to Rhomin. R-22 is not as conformable and fits Rhomax. | 2.41 |
| 12 | 622.273 | 4603.601 | 2132 | Excellent data except for minor noise on Rhoyx at >100Hz. Very small static and TEM 4-07 is conformable and fits Rhomin whereas 4-08 fits Rhomax.Therefore, no shift. | 1.25 |
| 13 | 622.077 | 4604.245 | 2119 | Excellent data. Phi noise >50Hz. Very small static and TEM R-24 is conformable and fits Rhomax. TEM 4-05 is less conformable and fits Rhomin. Therefore, no shift. 2D split at 100 Hz. | 1.15 |
| 14 | 624.172 | 4604.991 | 2158 | MT doubtful. Noisy and masked 0.2 to 5 Hz. BoC not well imaged. Very small static split but resistivity is very low and M23, R19 and n122 are much higher than Rhomax. Therefore, shifted up. D48 is less conformable and much higher than Rhomax. No reason given for noise in log. | 1.00 |
| 15 | 625.196 | 4604.731 | 2138 | MT OK. Phiyx is noisy and incompatible at >0.3 Hz and possible bias noise on Rhoyx at >10 Hz. Small static and TEM S21 conforms to Rhoxy and is close to Rhoyx. R19 is much lower in Rho and not conformable. | 1.31 |
| 16 | 625.639 | 4603.257 | 2153 | MT doubtful. Phase noisy, especially 0.1 to 2 Hz. Rho noisy and data masked from 0.1 to 1 Hz. Moderate static. TEM M60 much higher and not conformable to MT. Resistivity not very low so not shifted initially. Not used in 3D inversion. | 2.15 |
| 17 | 627.082 | 4602.820 | 1743 | MT doubtful. Severe noise distortion and so masked from 0.1 to 10 Hz. Poor resolution of clay cap. No 1D model. Apparent dimensional distortion at <0.1 Hz. Very small static and S20 conformable and matches MT. | 1.00 |
| 18 | 627.465 | 4604.740 | 1700 | MT usable. Noise at >20Hz and masked. Good MT data at <20 Hz. Small static split and no TEM. | 1.73 |
| 19 | 629.053 | 4605.292 | 1541 | MT OK. Inconsistent Phi from 0.7 to 4 Hz and noisy Rho masked at >100 Hz. Very small static split. TEM 100 almost conformable and higher than Rhomax. . | 1.85 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| 20 | 627.077 | 4607.046 | 1888 | OK data but noisy at 0.2 to 5 Hz and masked 4 points. Smoothing seemed to work for inconsistent Phiyx from 0.1 to 7 Hz. TEM S10 is conformable and between modes so no shift. | 1.89 |
| 21 | 629.148 | 4607.763 | 1546 | OK. Smooting seemed to adjust inconsistent Phiyx from 1 to 7 Hz. Masked 4 points at >100 Hz. TEM 101 conformable to Rhomax shallow but higher deep. | 1.79 |
| 22 | 623.381 | 4603.867 | 2352 | MT usable but close to n102 which is better. Very noisy phase at <0.1 Hz. Rho also noisy and so masked 0.1 to 10 Hz. Poor resolution of clay cap resistivity and base. TEM n102 is aligned just a bit below Rhomin, making this seem more reasonable than it initially looked with MT station n102. This MT station is near station n102 which is noisy but much higher quality, except for 2D split at high frequency. | 1.96 |
| 23 | 621.401 | 4603.093 | 2159 | Excellent MT data. TEM 3-12 and 3-13 are both coincident with Rhomin. Rhomax is still converging to Rhomin from 2D distortion at 200 Hz so probably no static but split at highest frequency must be included in 2D or 3D model.. | 1.00 |
| 24 | 621.311 | 4604.386 | 2104 | MT OK. Data is noisy from 0.15 to 5 Hz and near 70 Hz so masked 4 points TEM 4-04 conforms and is in middle of parallel Rhomax and Rhomin so static applied. TEM R-17 fits Rhomax. D16 is very much higher and not conformable. | 1.98 |
| 25 | 619.853 | 4604.301 | 2071 | MT doubtful. Serious lightening noise. Noisy 0.2 to 1.1 Hz and masked. Rhoyx has near maximum rate of increase in resistivity from 1 to 0.1 Hz to be consistent with 1 or 2D assumptions. TEM 6.16 fits between parallel modes shallow but not deep. Not used in 3D inversion. | 1.85 |
| 26 | 620.536 | 4603.602 | 2105 | OK. Masked 1 point. TEM U-04 conforms between parallel modes. TEM 3-09 conforms to Rhomin. | 1.96 |
| 27 | 619.929 | 4605.320 | 2057 | MT phase and parts of rho jittery but smoothing looks OK. Noisy near 1 Hz and masked 2 points. TEM between modes and conformable to Rhomax. . | 2.17 |
| 28 | 619.076 | 4603.640 | 2101 | MT usable. Phase is noisy and inconsistent near 0.5 Hz. Rhomin unrealistically low near 1 Hz. Smoothed curve probably OK. Masked 1 to 3 Hz and >70 Hz. TEM 2-01 is conformable between the parallel modes. | 1.72 |
| 29 | 619.137 | 4605.583 | 2042 | MT usable. Noise on Phi from 0.1 to 1 Hz smoothed. Noise on Rho so masked >150 Hz and <0.002 Hz. Small static. TEM OP-3 almost conforms close to Rhomin. | 1.28 |
| 30 | 618.108 | 4604.734 | 2068 | MT usable. Noisy and masked 0.1 to 0.3 Hz and <0.007 Hz. Static unclear because 2D split may be at highest frequency. TEM R-08 almost conforms shallow to Rhomax. R-12 almost conforms shallow between Rhomax and Rhomin. | 1.28 |
| 31 | 616.833 | 4604.807 | 2041 | Very good data with phase noise 50 to 100 Hz. TEM U18 is roughly conformable to Rhomax. | 1.61 |
| 32 | 620.569 | 4605.761 | 2074 | MT usable. Noisy but smoothing seems to work. Not as bad as 38. Masked 1 to 10 Hz and <0.01 Hz. TEM R-10 not conformable but between modes so no static indicated. | 1.00 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| 33 | 621.274 | 4607.903 | 2269 | Very good data. TEM OR-09 matches Rhomax. OR-13 is not conformable. Because of the distance of the TEM and the small split, no static was applied. | 1.59 |
| 34 | 621.452 | 4606.918 | 2220 | MT OK. Masked >70 Hz and <0.007 Hz. TEM M19 and R-07 slightly higher than and conformable to Rhomax. OR-09 matches Rhomax. | 1.75 |
| 35 | 619.716 | 4608.308 | 2282 | yx very poor and most points masked at <1 Hz. TEM OR-12 and OR-13 fit between the modes. Not used in 3D inversion. | 1.00 |
| 36 | 618.806 | 4607.367 | 2155 | MT usable. Phase is inconsistent from 0.3 to 10 Hz but smoothing seems to work well. R04 fits Rhomax shallow and M21 fits Rhomin. Static small or zero so no correction. | 1.00 |
| 37 | 623.098 | 4606.885 | 2164 | MT usable. MT phase is very noisy 0.1 to 4 Hz. Large static. TEM OP1 is conformable and higher than Rhomax. U19 is less conformable but similar. | 3.33 |
| 38 | 622.541 | 4606.906 | 2171 | Very noisy but smoothing seems acceptable, although yx is doubtful. Large static. TEM U19 not very conformable but between modes so no correction despite large static. | 5.18 |
| 39 | 622.849 | 4609.225 | 1987 | High quality but phase is inconsistent from 0.1 to 5 Hz. TEM S18 matches Rhomax. | 1.79 |
| 40 | 622.198 | 4609.398 | 2018 | Very good with a few noisy phase points. TEM R-01 is not conformable but near Rhomax. S18 between modes. | 2.44 |
| 41 | 624.208 | 4602.893 | 2185 | Noise jitter, especially in phase but smoothing seems to work. Static unlikely to be large but noise makes difficult to assess. OK but masked 2 high frequency points. TEM n107 not overlapping but seems much too low. | 1.00 |
| 42 | 619.539 | 4600.840 | 2013 | Very good data except probable noise bias at >100 Hz which has no practical effect. TEM 5-09 fits Rhomin so corrected to high frequency split at 300 Hz. D14 is conformable to Rhomax but is farther away than 5-09 and is higher than Rhomax. | 1.30 |
| 43 | 615.751 | 4607.317 | 2125 | Noisy and heavily masked. Rhoyx seems OK and Phiyx can be smoothed. However, Rhoxy and Phixy are not usable from 0.1 to 20 Hz. TEM Tx38 is conformable shallow but not deep. S-11 is similar. D04 is not at all conformable and is higher than Rhomax. | 1.34 |
| 44 | 614.237 | 4606.338 | 2172 | Good data. Noise on one or other mode at 5 frequencies but smoothed without masking. TEM S10 and Tx23 match Rhomax. | 1.43 |
| 45 | 613.414 | 4605.738 | 2143 | Very good data except masked <0.002 Hz. Tx14 is conformable but much lower than Rhomin. There is no static split between the modes so no correction made. | 1.00 |
| 46 | 612.632 | 4603.937 | 2140 | Noisy from 0.5 to 7 Hz and masked scattered points in that range. Static is large. TEM U09 is conformable between modes, closer to Rhomax. U13 is near average of modes. | 3.33 |
| 47 | 611.865 | 4602.630 | 1966 | MT usable. Noise and/or distortion from 0.2 to 5 Hz so masked. At 0.1 Hz perhaps 3D distortion. M06 is much higher than Rhomax. | 1.23 |
| 48 | 615.036 | 4604.222 | 2072 | MT high quality. Small static. TEM U07 roughly fits but is not conformable. Closer to Rhomin shallow, Rhomax deep. | 1.41 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| 49 | 621.827 | 4603.932 | 2132 | MT generally OK despite noise. Smoothed noisy high frequencies instead of masking. TEM 4-05 and 4-06 conformable to Rhomax and close to Rhomin. | 1.30 |
| b013 | 612.448 | 4602.085 | 2033 | Good. Slight static. Sirotem much lower than Rhomin so used Geonics 095 which fits modes. MT noise at 5 hz. Phase noisy < 5 Hz. 3D .5 Hz. 1D to 0.5 Hz. NW max polarization at <0.5 Hz. | 1.45 |
| b018 | 612.891 | 4601.895 | 2025 | Good. Polarization EW at 1 Hz and NW at <0.1 Hz. Used Geonics M08. Sirotem neg static larger but fit xy. 3D notch in yx. | 2.00 |
| b022 | 613.087 | 4603.112 | 2147 | Good but cautious use at >2000 m depth. NW max polarization at <1Hz. Rhomax up at near 45deg and Phi approached 0. TEM U09, M24, no static. Sirotem much lower than Rhomin. HF split and divergence | 1.00 |
| b030 | 613.860 | 4601.134 | 2007 | Good with limited use. Good shallow but very questionable deep. Rhomin(xy) fits Sirotem and 096. From 0.07 to 10 Hz xy shows a bias to lower resistivity. PA and Torq inconsistent phi and rho, especially XY from 0.1 to 10 Hz and YX 0.5 to .1 Hz yx. Rhoyx has >45 degree increase from 0.5 to 0.07 Hz and Phixy is out of quadrant. Polarization NE at 1 Hz and NW at <0.1 Hz. Possible HVDC coherent noise. | 1.84 |
| b031 | 613.920 | 4602.838 | 2146 | Good. Slightly noisy at transition to base of clay cap. Probable>45deg Rhoxy possibly due to HVDC noise makes resolution below top of reservoir doubtful. Sirotem static looks good. M24 distant & gives large + static. Moderate Rho noise and severe Phi noise <1 Hz. Almost 1D to 1 Hz. Polarization max NW <1 Hz. | 1.75 |
| b042 | 614.543 | 4603.004 | 2147 | Good. Sirotem looks good but M24 is in middle. Low noise until 1 Hz. Some mild phase distortion 5 s. Mild xx-yy distortion >100 Hz. Lower noise than b031. When stripped, Rho xy and yx are discontinuous at 1 Hz. Polarization NW <0.1 Hz. | 1.39 |
| b053 | 615.531 | 4601.592 | 2186 | Good. Rhoyx noisy at transition to base of cap but Phiyx smoothing looks OK. Sirotem very noisy & down, S27 up. Static shifted to Rhomax. Noise yx 0.1 to 1 Hz.. Smooth through it. Almost 1D >1Hz. Polarization NW max at <0.1 Hz. | 1.30 |
| b055 | 614.848 | 4598.779 | 1863 | Good. S25 matches yx. Sirotem noisy and absurdly neg. 098 & M16 match at highest freq but not conformable. Polarization NW at <1Hz. | 1.71 |
| b056 | 615.654 | 4600.286 | 2012 | Good. Noise and masking from 0.1 to 0.3 Hz does not affect resolution. Masked bias to lower rho >1000 Hz. Very neg Sirotem static but S26 in middle. Distorted Rhoxy at <0.1 Hz. Polarization EW at <1 Hz and WNW at <0.1 Hz. | 2.40 |
| b068 | 616.537 | 4600.849 | 2051 | Good. Noisy 0.3 to 0.7 Hz. Distortion at <0.2 Hz. Polarization NW at <0.1 Hz. TEM 5-01 diff slope but same rho as MT. S26 close to yx (low), S27 much lower. Very neg Sirotem static. Used S26 slope and 5-01 average resistivity. | 1.25 |
| b070 | 616.542 | 4599.803 | 2013 | MT resolution of base of clay cap limited. Noisy at <.3 Hz. Sirotem conformable but much lower. 5-01 not conformable but same. S25 conforms but is high. Probably not reliable for BoC estimate.. | 1.20 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| b074 | 616.831 | 4598.703 | 1929 | MT good shallow, possibly usable at base of clay cap. Very noisy < 1Hz. Sirotem huge unrealistic static to lower rho. M17 in range as Rhoxy but not conformable. S25 fits xy perfectly. | 1.69 |
| b087 | 618.158 | 4600.382 | 2010 | Good. MT noisy 0.1 to 0.5 Hz and masked. Noisy polarization NE max. TEM 5-04 implies small static but higher rho at depth. 5-05 does not fit. Sirotem huge neg static. | 1.25 |
| b095 | 618.401 | 4602.236 | 2063 | Good. 2D split at highest frequency. xx and yy high (3D?) at <0.1 Hz. MT Rho low noise but Phi noisy 0.1 to 0.5 Hz. TEM 1-05 fits Rhoxy. Sirotem not usable. NW max polarization at all frequencies. | 1.63 |
| b101 | 618.854 | 4600.821 | 2043 | Good. 2D split at highest frequency. MT has unrealistic slope at 0.1 Hz, perhaps HVDC interference. Very noisy Rhoyx 0.08 to 0.5 Hz. 2D split at 300 Hz. Very good Sirotem fit to Rhoxymax. 5-05 perfect fit, 1-10 close to Rhoxy. N polarization. Stripping does not remove it. | 1.49 |
| b116 | 619.894 | 4607.573 | 2306 | Good. Low noise >1 Hz. High but smoothable noise 0.1 to 0.5 Hz on Phiyx, moderate on Rhoyx. Inflection at 2Hz. yx discontinuity at .02 Hz. Sirotem resistivity much too low and not conformable. OR-12 is close fit to Rhoyx (high). Polarization at <0.1 Hz NW. | 1.58 |
| b127 | 620.572 | 4600.822 | 1955 | Good. Low noise. TEM b127 fits Rho-yx-low very well. TEM 2-12 fits Rhoxy-high except deep. | 1.41 |
| b154 | 622.142 | 4607.414 | 2210 | Good but static is large. Low noise except 0.07 to 0.5 Hz on rhoyx-low. Large static. Both curves are flat <.05 Hz, possibly distorted. Sirotem resistivity is close to Rhoyx-high. TEM OR-09 is very conformable to Rhoyx (high) | 4.95 |
| b170 | 622.913 | 4608.231 | 2068 | Good. Low noise except 0.1 to 0.5 Hz on Rhoyx-low and Phiyx. R-02 is close fit to Rhoxy (high). Sirotem resistivity is low but conformable to MT. | 1.79 |
| b178 | 623.415 | 4607.979 | 2100 | Good. Low noise but masked very noisy Rhoyx-low 0.1 to 0.5 Hz due to upward bias. Sirotem between and conformable. R-03 very conformable to Rhoxy but implies large + static on both modes. | 1.87 |
| b197 | 624.528 | 4607.846 | 2184 | MT is noisy, especially Rholow, at <1 Hz. Swapped modes at <1Hz. Sirotem is slightly lower than Rholow but comfortable. R-03 is almost conformable and half way between the MT curves. | 2.49 |
| C01 | 617.559 | 4606.885 | 2098 | MT OK. Noisy part of data is deeper and well constrained by smoothing so 1D inversion detects BoC reliably. Noisy from 0.2 to 0.9 Hz. Phiyx inconsistent with Rhoyx 1 to 5 Hz until selected points masked from 0.2 to 8 Hz. Also masked <0.01 Hz. No MT static split. TEM U10 not conformable and lower than but close to Rhomin. D05 is conformable but higher than Rhomax. | 1.00 |
| C02 | 623.629 | 4607.189 | 2107 | MT doubtful for base of clay. Noisy station. Rhoxy and Phixy are not usable from 0.1 to 7 Hz. TEM OP-1 is lower than Rhomin but conformable. Although this station does not reliably resolve the BoC, it constrains the minimum and maximum thickness of the conductor. | 1.00 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| C03 | 615.477 | 4605.622 | 2072 | MT usable. Relatively resistive station that, because conductor is >25 ohm-m and shallow, the BoC is resolved despite noise. Masked from 0.1 to 1 Hz. . TEM 114 is conformable and close to Rhomax. | 1.90 |
| C04 | 610.845 | 4603.295 | 1976 | MT probably usable. Noisy and masked many points from 0.15 to 2 Hz. TEM 027 not conformable shallow but somewhat conformable deep at higher rho than Rhomax. | 2.33 |
| C05 | 613.828 | 4603.915 | 2132 | MT doubtful. Noisy, especially on Rhoxy. Although Rhoyx and Phiyx appear to be good except at gaps from 0.1 to 2 Hz, Phiyx seems to be inconsistent with Rhoyx at >10 Hz. TEM M25 is almost conformable to Rhomax but is much higher. | 2.41 |
| C06 | 622.787 | 4604.546 | 2150 | MT probably OK. Noisy and masked from 0.1 to 1 Hz. BoC seems to be resolved. Small static. TEM M22 is almost conformable between modes. OR1 is more conformable to Rhomax. D47 is much higher than Rhomax and not at all conformable. | 1.41 |
| C07 | 618.179 | 4603.224 | 2051 | MT utility for base of clay in doubt. Noisy and masked from 0.07 to 2 Hz. Constrains depth to top of the conductor and indicates that it is moderate resistivity. Static split is small. TEM 1-02 is almost conformable between modes. | 1.16 |
| C08 | 619.886 | 4602.920 | 2060 | MT doubtful but possible base of clay. Noisy and masked from 0.2 to 1 Hz. Small static. TEM 2-04 fits Rhomax shallow and Rhomin deep. 2D split at 2 Hz. Despite noise, probably implies a maximum depth to BoC. | 1.76 |
| C09 | 625.255 | 4602.008 | 2062 | MT OK. Low noise except where masked 0.1 to 6 Hz.. Small static split in this rotation. TEM M61 is not conformable and much higher resistivity than Rhomax. TEM plots show that it did not detect a conductor and so TEM static was unreliable. | 1.44 |
| C10 | 618.144 | 4600.511 | 2022 | MT probably OK. Noisy and masked 0.3 to 1 Hz. TEM 5-04 is conformable to Rhomax shallow. Rhoxy and Rhoyx are still converging at 100 Hz and so no static applied. | 1.43 |
| C11 | 619.453 | 4600.488 | 2000 | MT possibly OK. Noisy from 0.3 to 1 Hz on Rhoxy. Rhoyx and Phayx are inconsistent for much of the data at <1 Hz. Rhoyx slope is >45 degrees from 0.07 to 0.2 Hz and so is suspect. However, Rhoxy variance appears to be low on CGG plots, perhaps indicative of coherent noise distortion. Therefore, yx data at <1 Hz is masked and the base of the clay cap is not resolved. TEM 5-08 and 5-09 fit Rhomax. 1-12 conforms but less well to Rhomax. TEM splits at highest frequency so the static split is uncertain but probably large. The resistivity of Rhomin is too low to support a realistic model. Therefore, Rhomin was adjusted up. Because of lack of Rhoyx at low frequencies, the relatively clean Rhoxy was used for the 1D inversion. | 1.43 |
| C12 | 622.869 | 4601.236 | 2031 | Good data except where noisy and masked from 0.2 to 0.9 Hz. TEM almost fits Rhomin but it is distant and, given the small size of the static split, no static shift was applied. Thick surface resistor >980 m so the clay cap is deep but still conductive. | 1.38 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| C13 | 629.208 | 4602.195 | 1629 | Good data except where Rhoxy is noisy and masked from 0.1 to 1 Hz. Phiyx is also noisy but smoothing seems to be effective. There is no static split. TEM is very high, not conformable, and very likely to be erroneous, not having detected a conductor. | 1.00 |
| C14 | 624.155 | 4599.692 | 1781 | Good data except where both modes are masked from 0.12 to 1.2 Hz due to noise. There is only a slight static split. Resistivity is very high. TEM 081 is even higher than Rhomax and not conformable. TEM is unreliable because of the great depth to a conductor and no MT shift was made. Conductor is deep but <10 ohm-m, although this is not reliable due to masking of data and 2D distortion. | 1.34 |
| C15 | 608.585 | 4597.514 | 1703 | Good data except from 0.2 to 2 Hz where noisy data was masked. TEM 031 never encountered a conductor and so is unreliable. It is unconformable and higher than Rhomax. | 1.00 |
| C16 | 625.875 | 4595.421 | 1600 | Good data except from 0.2 to 2 Hz where noisy data was masked. TEM would not have worked to provide a static confirmation because the top of the conductor is very deep. | 1.00 |
| C17 | 630.290 | 4594.004 | 1456 | MT OK. Station similar to C16. Good data except from 0.2 to 2 Hz where noisy data was masked. TEM would not have worked because the top of the conductor is very deep. | 1.00 |
| n004 | 611.223 | 4604.454 | 2047 | Good to base of clay, although static is large. Stripping does not work as well as expected at >1 hz. Phi at >100 Hz biased. Phi very noisy <1Hz. Rho noisy. 3D at <1 Hz. Sirotem closer to Rholow but possible negV. Tx6 and Tx3 are closer to Rhohigh. Used Sirotem. | 7.30 |
| n005 | 611.306 | 4606.924 | 1985 | Good. Low noise except xx-yy noise causes earth to not restart. Sirotem conformable but lower than Rholow. Tx4 is between the curves, conformable and similar to Tx3. | 2.43 |
| n007 | 611.892 | 4605.021 | 2120 | Good. Huge MT static split so 1D inversion is doubtful. Sirotem fits and all others higher. M26 is closer. | 2.91 |
| n008 | 611.729 | 4607.949 | 1951 | Good. High frequency xx and yy noise except when in PA rotation. Sirotem fit Rholow. Station 116 fits Rhohigh but not very conformable. Initial test by using Sirotem. D28 is conformable but much higher in resistivity. | 3.75 |
| n010 | 612.556 | 4607.658 | 2016 | Good. MT noisy 0.1 to 0.2 Hz. Sirotem is lower than Rholow. Tx9 is excellent fit to Rhohigh | 1.74 |
| n013 | 612.814 | 4609.058 | 1986 | Good. MT low noise except 0.1 to 1 Hz. Resolution of base of cap is made doubtful. Sirotem is lower than Rholow. M36 is a bit higher than Rhohigh and not conformable. | 3.97 |
| n014 | 612.838 | 4604.348 | 2137 | Good. Noisy Phi at <5 Hz. smoothed. Sirotem is much lower than Rholow. U13 fits Rholow. | 1.39 |
| n016 | 613.190 | 4607.997 | 2035 | MT is good and low noise except static is large and xx and yy are large at >10Hz. MT does not strip well. Sirotem between curves and conformable. Tx15 fits Rhomax perfectly. | 6.90 |
| n017 | 613.207 | 4606.250 | 2135 | Good but large static. Stripping produces divergent App Rho due to noise in xx and yy terms. Rho and Phi noisy 0.1 to 1 Hz and smoothing looks OK. M27 fits perfectly with Rhomax. Sirotem not conformable but close to Rhomax. S10 is higher. Tx14 is slightly higher than Rhomax. | 5.24 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| n018 | 613.399 | 4606.888 | 2128 | Fair but very large static. Could not strip MT suitably. MT is very distorted <1Hz. Rhoxy 45 degrees at <1 Hz.. Noisy 0.1 to 1 Hz. Sirotem between curves and conformable, closer to Rhomax. . Tx16 slightly higher than Rhomax. | 11.11 |
| n021 | 613.864 | 4603.522 | 2135 | Good. MT Noise from 0.2 to 2 Hz is smoothed. Sirotem is a bit lower than Rhomin. M24 is close to Rhomax. M25 is higher. Chose to make no static adjustment. | 1.41 |
| n022 | 613.904 | 4605.293 | 2110 | Good. Noise and gap from 0.1 to 0.2 Hz is smoothed. Sirotem near Rholow but not conformable. Tx14 and M25 fits Rhomax. S10 and Tx10 are slightly higher. | 1.67 |
| n023 | 613.928 | 4607.139 | 2119 | MT is OK to near clay cap base. BoC is either 402 or, if 11 ohm-m is considered, 1527 m. Used Torquil Smith decomposition because PA had >45deg App Rho. Because of apparent 3D effect causing a >45 deg rise in the PA version, the resolution of the thin resistive zone over a deep conductor characteristic of shallow permeability over a deeper impermeable zone is less well resolved than other stations nearby. Sirotem fairly conformable and between curves. Tx16, Tx18 and Tx19 are conformable but higher than Rhomax. | 2.89 |
| n026 | 614.209 | 4611.671 | 1943 | Good, but large static. MT 1D or pseudo-1D at all frequencies. Slightly Noisy from 0.1 to 1 Hz. Sirotem is almost conformable to Rhomin. 118 is higher than Rhomax and less conformable. | 4.15 |
| n029 | 614.296 | 4608.412 | 2088 | High quality MT. Small static but poor conformance to Sirotem. Tx26b is conformable and overlays Rhomax. | 1.31 |
| n030 | 614.767 | 4605.472 | 2078 | Good. Noisy from .05 to 1 Hz does not affect higher frequencies.. Sirotem probably has a misleading very negative static. S10 matches Rhomin. U-18 and 114 are close to Rhomin but not conformable. Resistivity of clay is high. Station is 2D shallow. | 1.91 |
| n032 | 614.908 | 4607.797 | 2128 | Resolves base of clay. Usable but noisy and masked 0.1 to 0.8 Hz. 1D at >0.5 Hz. Inversion shows two low resistivity zones sandwiching a high, suggestive of shallow resistive permeable zone over a deeper impermeable zone. Sirotem is conformable but lower than Rhoomin. M41 is conformable and exactly in middle of modes. Tx29b and Tx32 are conformable with Rhomax. | 2.05 |
| n033 | 614.857 | 4602.298 | 2159 | Good. Low noise MT. Simple inversion. Sirotem is conformable but has a very negative static. 6-03 and M09 are similar. M24 is slightly< Rhomin. | 1.63 |
| n034 | 615.133 | 4606.393 | 2098 | Good. Slight split at 10 Hz is bigger at 2 Hz. Sirotem is noisy, lower than Rholow and not very conformable. Tx23 is between modes but not conformable. 114 is near Rholow but not conformable. Made no static. | 2.21 |
| n035 | 615.094 | 4603.316 | 2126 | Resolution of base of clay cap may be affected by noise bias to higher rho on Rhomin from 1 to 10 Hz. Smoothing seems to work. High xx noise. Sirotem is noisy and lower than Rhomin but conformable. 6-01 overlies Rhomin. 1D not very conductive. | 1.59 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| n036 | 615.152 | 4610.060 | 2050 | Good. MT is very noisy and distorted from 0.1 to 1 Hz but smoothing worked and so was usable. Small static split. Sirotem is noisy and lower than Rhomin but conformable. Tx39 and Tx28 fit Rhomin. M42 is similar to Sirotem. 111 is close to Rhomax but not conformable. | 1.37 |
| n037 | 615.156 | 4607.134 | 2131 | Good. Small static split. MT low noise except for a few points near 0.1 and 0.3 Hz that are masked. Sirotem is noisy and lower than Rhomin but mostly conformable. S11 is between the modes and somewhat conformable. Conductor is resistive. | 1.47 |
| n038 | 615.164 | 4608.956 | 2103 | Good at >1 Hz. Base of clay resolution may be questionable. Small static. Stripped data look less noisy. Phase is unreliable at <1 Hz. Double layer in conductor may be generated by noisy phase at <1 Hz. If lower layer is cap then BoC is 2096 m, if not then 700 m. Noise at 1 Hz makes this uncertain. Sirotem slightly lower than Rhomin and conformable.Tx32 is slightly higher than Rhomax. | 1.37 |
| n043 | 615.562 | 4607.992 | 2176 | MT good quality but >1D distortion starts at >300 Hz so 1D inversion is less reliable. Some xy bias 0.1 to 1 Hz smoothed. Sirotem lower than Rhomin. M41 is slightly lower than Rhomim. Tx35 fits Rhomin, Tx36 is close. | 1.78 |
| n045 | 615.982 | 4603.055 | 2104 | MT noisy at < 1Hz and so base of clay is unreliable. >1D at >300 Hz so 1D inversion is also doubtful. Noisy and masked from 0.05 to 0.5 Hz. Sirotem and TEM 6-04 higher than Rhomax. MT 1D model shows some evidence of reversal but data is too noisy for this to be reliable. | 1.67 |
| n046 | 616.104 | 4608.795 | 2129 | Good with no static split but MT >1D split at 1000 Hz so 1D inversion may be in doubt. Sirotem conformable and much lower than Rhomin. Tx37 not conformable and similar to Rhomax. | 1.00 |
| n047 | 616.153 | 4605.510 | 2056 | Good with no static split, although >1D resistivity curves at <50 Hz. Sirotem not conformable and lower. U18 is conformable and slightly lower, 114 conformable and slightly higher. | 1.00 |
| n048 | 616.241 | 4602.067 | 2282 | Noisy and masked from 0.06 to 2 Hz so the base of the clay is not imaged. Small static. Sirotem is conformable but much lower than Rhomin. S27 fits Rhomin perfectly. | 1.43 |
| n049 | 616.248 | 4610.334 | 2005 | Usable although noisy from 0.1 to 0.5 Hz. Large static split. Sirotem nearly conformable and fits with Rhomin. 111 conformable and fits with Rhomax. | 5.65 |
| n052 | 616.432 | 4611.319 | 1991 | High quality MT except large static split. Sirotem fits Rhomin. TEM M39 and M43 fit Rhomax. TEM 110 not conformable.2D split at lowest rho. | 3.89 |
| n055 | 617.250 | 4603.110 | 2058 | Good, except >1D at <100 Hz. MT station is high quality at >1 Hz and mildly noisy at <1 Hz. No static split. Sirotem higher than both modes and conformable to Rhoyx. TEM 6-07 higher yet and conformable. TEM 6-08 is higher but not conformable. | 1.00 |
| n056 | 617.356 | 4608.006 | 2248 | Good but small >1D effect at >300 Hz. Sirotem aligned with Rhomin. High quality MT. | 1.28 |
| n057 | 617.449 | 4601.831 | 2257 | Does not resolve base of cap. Noisy so masked 0.01 to 8 Hz. Sirotem much less than Rhomin. 1-06 matches Rhomin and is conformable. 6-08 much less and not conformable. | 1.87 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| n060 | 617.811 | 4606.973 | 2102 | Good. No static split. High quality MT except slight noise 1 to 5 Hz. Sirotem much lower than Rhomin. D05 is almost conformable but higher than Rhomax. U10 almost conformable and generally matches Rhomin and Rhomax. | 1.00 |
| n061 | 617.905 | 4605.868 | 2048 | Good. Moderate static. Sirotem much lower and not conformable. U01 is not conformable but between modes. U02 is much lower. R05 and R08 fits Rhomax and is conformable. | 1.90 |
| n063 | 618.294 | 4604.299 | 2074 | MT high quality with a moderately large static. Sirotem fits Rhomin. R-12 fits Rhomax but is not conformable at depth. No static adjustment made. | 2.76 |
| n065 | 618.286 | 4612.288 | 1863 | MT good with small static. Almost 1D. Sirotem much lower than Rholow. M45 not conformable but fits Rhohigh shallow. D12 is higher than Rhomax but nearly conformable. | 1.42 |
| n066 | 618.569 | 4603.784 | 2091 | Good but possible noise bias to higher Rhoyx at 1 Hz, close to base of clay. MT Rhomin and Rhomax are pseudo-1D except from 0.3 to 3 Hz. Sirotem much lower than Rholow but 6-11 fits Rholow perfectly. | 2.24 |
| n067 | 618.494 | 4611.087 | 1964 | MT good quality except large static. Masking of noisy points 0.07 to 0.2 Hz does not affect results. Sirotem not conformable but almost fits Rholow. M44 not conformable but fits Rhohigh shallow. | 3.70 |
| n068 | 618.568 | 4606.451 | 2118 | Very good MT data except 0.8 to 3 Hz which is probably smoothed well enough to minimize effect on resolution of the base of the clay cap. Sirotem far lower than Rholow. R-05 between Rhohigh and rholow shallow. | 1.79 |
| n072 | 619.036 | 4603.160 | 2083 | MT good through clay cap but noisy deeper from 0.1 to 1 Hz, especially phi, so masked most of this interval. Very small static. TEM used 2-02. Sirotem large negative static. 2-01 close to Rhohigh and 2-03 close to rholow. 1-03 close to Sirotem and 1-02, 3-03 similar with negative static. 2-02 missing. | 1.21 |
| n073 | 618.962 | 4604.839 | 2065 | Good. Very small static. TEM U01 fits Rholow perfectly. Sirotem much lower than Rholow. R-12 fits Rhohigh shallow. R-06 too high. OP3 conformable but a bit lower. | 1.25 |
| n075 | 619.193 | 4602.423 | 2066 | MT is low noise but exhibits >1D effects from 1 to 10 Hz. Sirotem conformably fits Rhomin. TEM 077 fits Rhomin shallow. 3-03 is in middle and less conformable. | 1.83 |
| n078 | 619.538 | 4604.129 | 2077 | Probably OK. Edit noise 1.2 to 3 Hz. Repeat had mode discontinuity in PA at 0.1 Hz that does not affect base of clay. Switched to Torquil Smith decomposition. Small static split but Sirotem much lower than Rhomin. 6-14 and 6-15 slightly lower with 6-14 closer and conformable shallow. First occupation not useable. | 1.35 |
| n080 | 620.020 | 4602.409 | 2062 | High quality MT. Sirotem conformably fits Rholow. TEM 2-06 is slightly higher, between Rholow and Rhohigh. | 1.75 |
| n082 | 620.050 | 4604.899 | 2067 | Good, except >1D at >300 Hz. Masked >700 Hz. Sirotem slightly lower and slightly unconformable to Rhomin. R-13 is higher and not conformable to Rhomax. | 1.00 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| n083 | 619.955 | 4603.683 | 2092 | Good. Small static. Some masking near 0.1 hz. Sirotem much lower than Rhomin. R-15 between modes closer to and conformable with Rhomax. D20 is similar shallow but then much too high. | 1.89 |
| n085 | 620.420 | 4604.428 | 2100 | Usable but uncertain static. Split from 10 to 100 Hz may imply distortion at >100 Hz.Sirotem close to Rhomin. 6-18 less conformable but between modes. Masked >1000 Hz. | 1.15 |
| n086 | 620.618 | 4602.974 | 2134 | Good MT with >1D split at 10 Hz and 3D at <0.1 Hz. Sirotem lower than Rhomin. 3-08 very close to Rhomin and conformable. | 1.19 |
| n088 | 620.969 | 4602.065 | 2071 | Good. Small static but >1D at 100 Hz. Sirotem slightly higher than Rhomax and conformable. S22 starts at Rholow but gets much higher than Rhomax at lower frequency and is not conformable. | 1.32 |
| n090 | 621.376 | 4603.827 | 2138 | MT OK. Very small static. Sirotem fits Rholow. 4-05 fits Rhohigh with very conformable. MT 1D inversion suggests thin conductor over an intermediate resistor. | 1.50 |
| n093 | 621.352 | 4601.290 | 1988 | Good. Large static. Sirotem lower than Rhomin and not conformable. 5-15 not conformable but close to Rhomin. High quality MT. No static made. Pseudo-1D until <0.1 Hz. | 2.37 |
| n097 | 622.116 | 4602.567 | 2111 | Good. Sirotem matches Rhomin. 4-09 matches Rhomax. R22 higher than Rhomax and not conformable. S22 is much lower and not conformable. MT very high quality and pseudo-1D. | 2.03 |
| n100 | 622.653 | 4601.406 | 2055 | MT Fair. Probably resolves base of clay cap reliably. Rho and Phi is noisy 1 to 8 Hz. MT Rho may be distorted at <0.1 Hz. Sirotem much lower than Rhomin. TEM 5-20 very good fit to Rhomin. 4-15 and 5-19 are between the curves and not conformable. | 2.44 |
| n102 | 623.281 | 4604.304 | 2343 | Good but >1D split at high frequency. MT is noisy from 0.1 to 0.8 Hz, just below BoC. 2D split at >100 Hz and 3D at 0.2 Hz. Thin conductor over resistor. Sirotem is lower than Rhomin. R-18 is missing in field data report. | 1.66 |
| n103 | 623.003 | 4602.915 | 2128 | Good. Sirotem lower than Rhomin. 4-11 matches Rhomin. 4-10 a little lower and conformable. Noise Rhomin 0.3 to 1 Hz. | 1.73 |
| n106 | 623.754 | 4602.086 | 2068 | OK. MT noisy from 0.1 to 1 Hz. Perhaps less reliable for resolving depth of base of clay cap. Very small MT split. Sirotem much lower than Rhomin. 5-23 and 5-24 in middle but unconformable at depth. SEV D18 fits Rhomin shallow but becomes too resistive deeper. | 1.44 |
| n107 | 624.486 | 4602.955 | 2193 | Fair but masked 0.5 to 1.5 Hz makes base of clay cap uncertain. Rhomax might be distorted by HVDC <0.1 HZ or may be very >1D. Small MT static. Sirotem much lower than Rhomin. S-21 perfect fit to Rhomin. 5-24 between curves. M60 and M61 are much higher than RhoMax. | 1.50 |
| n111 | 617.036 | 4609.513 | 2136 | Good. Large static but average looks OK. Sirotem between curves and conformable. Tx41 is higher than Rhohigh. MT is low noise and almost 1D. | 3.86 |
| n114 | 618.199 | 4608.583 | 2327 | OK. Noisy around 0.1 Hz but base of clay defined because it is deep, thick and resistive. Sirotem lower than Rhomin. R-04 just below Rhomax. However, clay will be deep and not very conductive. Distortion below 0.1 Hz. | 2.30 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| n115 | 618.628 | 4609.760 | 2103 | Probably OK but distortion, possibly due to HVDC at <.05 Hz at base of clay cap. Large static. Sirotem between curves and conformable. S-14 is much more resistive than Rhomax. | 3.52 |
| n116 | 619.217 | 4608.637 | 2288 | Good. Deep thick clay cap. Sirotem lower than curves. Masked Rho and Phi noise 0.1 to 0.3 Hz . | 2.39 |
| n117 | 620.473 | 4606.569 | 2231 | Maybe OK. Static is large. MT is noisy at < 1Hz and so clay cap uncertain but probably resolved. Sirotem close to Rhomin and almost conformable. OR-10 and R-06 higher than Rhomax and conformable. | 3.26 |
| n118 | 620.759 | 4605.707 | 2070 | MT OK, resolves base of clay. Sirotem between Rhomin and Rhomax and almost conformable. R-10 is similar. R-11 is much lower. MT is noisy at < 1Hz | 2.06 |
| n119 | 621.138 | 4606.451 | 2194 | MT resolution of base of clay cap uncertain. MT is noisy at < 2Hz and is masked 0.1 to 2 Hz.. Sirotem between Rhomin and Rhomax and almost conformable. M20 and R06 are higher than Rhomax. | 1.91 |
| n120 | 623.186 | 4605.204 | 2140 | Good, although noise masked 0.08 to 1.2 Hz.Sirotem fits Rhomin well. OP2 is in middle of modes and conformable. OR-02 fits Rhomax. | 1.98 |
| n122 | 624.476 | 4605.122 | 2166 | Not usable for base of clay. Noisy at <8 Hz and masked. Detect top of clay cap but not base. Sirotem higher than both modes. Very poor station. | 2.67 |
| n200 | 621.938 | 4606.784 | 2159 | OK, although MT yx noisy at 1 Hz and both modes noisy and masked from 0.1 to 0.3 Hz. Rhomin noisier. Curves cross. Sirotem not conformable and lower than Rhomin. OR-08 fits Rhomin well. R-07 higher than Rhomax | 1.55 |
| n202 | 622.577 | 4604.535 | 2125 | Good. Sirotem aligned with Rhomin. OR-01, M22, and R-22 are aligned with Rhomax. D47 also fits Rhomax shallow but is much higher deep. Weak evidence of reversal complicated by more likely 2D split distortion. 3D at < 0.1 Hz. | 1.78 |
| n203 | 623.597 | 4607.377 | 2110 | OK but base of clay in doubt in 1D because of >1D or non-MT distortion at <0.01 to 0.2 Hz. Resolution below BoC poor. Sirotem between modes and almost conformable. OP-1 fits the same way. Possible HVDC distortion at <.01 Hz. | 4.74 |
| P01 | 613.692 | 4608.642 | 2046 | MT OK. Small static. M38 is partly conformable and aligned with Rhomax. Data OK except Rhoyx is biased to higher resistivity near 0.3 Hz and Phiyx is inconsistent at >0.5 Hz. Smoothing seems to work OK.. | 1.53 |
| P02 | 612.706 | 4606.591 | 2140 | MT noisy in clay cap from 1 to 8 Hz so base is poorly resolved. Masked 1 to 5 Hz and 0.5 to 5 Hz on xy mode. TEM M27 is conformable and almost fits Rhomax. | 1.42 |
| P03 | 611.331 | 4605.706 | 2043 | MT OK. Phase at <1 Hz is noisy but smoothing seems to work. Rho is split and 3D at <0.9 Hz. Nearby TEM 115 is higher than Rhomax and not conformable whereas Tx5 conforms closely to Rhomin. | 1.73 |
| P04 | 609.097 | 4603.389 | 1965 | MT OK with sudden split at 1 Hz. Phi noisier at >3Hz but smoothing seems OK. TEM U14 is conformable and between curves. while 092 is less conformable and fits Rhomax. | 1.51 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| P05 | 620.793 | 4604.810 | 2076 | MT seems OK with smoothing working on Phi noise at 0.5 to 1 Hz. TEM 4-01 is not conformable and much higher than Rhomax. TEM data look OK but conductor at 350 m is 23 ohm-m which may have been too high to reliably detect. The <10 ohm-m conductor is at and 702 m almost as deep as the base of the MT conductor. Inversion of resistivity is very low at all depths after initial processing so consider raising resistivity as suggested by static. | 1.94 |
| P06 | 609.050 | 4605.170 | 1858 | MT OK with minor smoothed noise at <1Hz. TEM S03 conformable and between modes. Tz is noisy. | 1.37 |
| P07 | 620.144 | 4602.084 | 2055 | MT usable. MT has possible noise bias on Rhoxy to higher resistivity from 1 to 10 Hz and so masked, mostly Rhoxy. TEM 2-07 is conformable and fits Rhomin. | 1.37 |
| P08 | 610.474 | 4599.586 | 1817 | MT may not constrain base of clay well. MT from 0.3 to 50 Hz might be biased to high and low resistivity or possibly 3D or HVDC distortion at lower frequency gives the appearance of noise bias at higher frequency. Masked 0.3 to 50 Hz. TEM M18 is not conformable at all but is closer to Rhomax. Poorly constrained BoC. | 1.85 |
| P09 | 612.118 | 4601.245 | 1975 | MT is OK except two frequencies near 0.2 Hz masked. TEM M07 is conformable and between modes. Very low resistivity conductor. | 1.69 |
| P10 | 613.593 | 4601.730 | 2013 | MT OK. Noise is low. Small static. TEM M09 conformable and close to Rhomin. OK. Not masked on initial edit. | 1.23 |
| P11 | 619.380 | 4600.683 | 2008 | OK. TEM 5-08 not conformable and lower. 5-09 is conformable and lower than Rhomin. U03 is much higher than Rhomax and not conformable. MT shows no split at >60 Hz but seems to have separate static at <50 Hz. Decided not to shift Rhomax down. | 1.00 |
| P12 | 613.694 | 4599.758 | 1933 | MT possibly OK. MT seems to be distorted at <1Hz, perhaps by noise or HVDC distortion. Phase is inconsistent from 0.2 to 3 Hz. TEM 097 is not conformable and seems higher than Rhomax, but shallower part of TEM is on trend with middle of modes so no static correction made. | 1.00 |
| P13 | 615.662 | 4598.432 | 1866 | MT usable. Small static. Masked 2 noisy points. Phixy is inconsistent from 2 to 8 Hz. Smoothing seems OK for noise. TEM S25 is conformable and matches Rhomax. | 1.27 |
| P14 | 619.470 | 4599.482 | 1968 | High quality data. TEM 1-15 fits middle of the modes until deep part of the curve. Below 3 ohm-m conductor, 1D inversion shows 22 ohm-m layer not counted in initial BoC. | 1.00 |
| P15 | 620.715 | 4599.872 | 1942 | MT usable. Rho seems OK but Phi from 1 to 10 Hz is inconsistent with Rho, although smoothing looks OK. TEM 2-15 is not conformable but seems in middle of modes so no static made. 2-14 and 2-16 are both in the middle and very conformable. D46 is close to being conformable just a bit higher than Rhomax. | 1.92 |
| P16 | 619.217 | 4597.905 | 1830 | MT OK and pseodo-1D, although Phi inconsistent 0.1 to 0.8 Hz. Smoothing OK so not masked. TEM U05 is conformable and between modes. | 2.20 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| P17 | 614.580 | 4601.160 | 2038 | MT good quality. TEM M10 and M15 are both conformable to shallow MT and in middle of modes. | 1.39 |
| W01 | 617.366 | 4611.054 | 1974 | MT generally high quality. U08 almost conformable and close to Rhomax. M43 conformable but higher than Rhomax. D11 is less conformable and much higher. Thick basinal conductor. | 1.58 |
| W02 | 621.795 | 4610.091 | 1959 | MT OK. TEM R01 is higher than Rhomax . S14 is close to Rhomax. Slight noise. Thick basinal conductor. | 1.43 |
| W03 | 606.618 | 4614.863 | 1477 | MT generally high quality. Very thick basinal conductor. | 1.53 |
| W04 | 609.721 | 4611.731 | 1656 | High quality MT. Very thick conductor like intervolcanic basin. TEM 121 much higher than Rhomax. D40 implies similar static with much higher resistivity. Rhomin shifted up to Rhomax. | 1.30 |
| W05 | 611.735 | 4609.411 | 1817 | MT probably does not resolve base of clay cap. MT is noisy. App Rho discontinuities at band changes. Mid band on xy rhomax is biased to higher resistivity and so was masked. Details not reliable but probably resolves thick basin clays. TEM is nearby and higher than Rhomax but not conformable. | 1.54 |
| W06 | 614.761 | 4607.763 | 2128 | MT possibly OK. MT is noisy, especially phase, and so masked 1 to 3 Hz and near 0.1 Hz. Smoothing seemed to be effective for App Rho. Phase is inconsistent near 1 Hz.. Discontinuities at band changes. Tx31b is less conformable than Tx31 but fits MT Rho. | 1.00 |
| W07 | 618.533 | 4605.572 | 2045 | Rho MT is high quality but >1D split at >7 Hz so 1D inversion is in doubt. TEM U01 not conformable but fits between MT modes. U02 much lower | 1.41 |
| W08 | 621.488 | 4603.443 | 2135 | MT OK but large static. . Slight noise near 1 Hz. Phase generally noisy. TEM 3-13 is conformable and just below Rhohigh. 3-12 is similar. 3-14 is lower and conformable on | 3.60 |
| W09 | 605.520 | 4609.324 | 1624 | Good data with minor masking. Small static. D42 is higher than Rhomax. | 1.69 |
| W10 | 609.209 | 4607.566 | 1807 | MT OK although Rho has discontinuities at band changes. Small static. TEM S01 higher than Rhomax. | 1.41 |
| W11 | 612.279 | 4605.195 | 2118 | MT probably OK. Seems to be 3D or noise distorted to higher resistivity, especially <0.5 Hz. Masked 0.3 to 1.5 Hz. TEM M26 conformable and suggest slight shift up. D49 is much higher and not conformable. | 2.03 |
| W12 | 614.723 | 4602.193 | 2173 | MT OK. Data >15 Hz noisy and masked. MT is >1D split <15 Hz. Thin shallow alteration. TEM n033 is much lower than Rhomin and unrealistic for static. | 1.00 |
| W13 | 618.239 | 4598.497 | 1900 | MT OK and resolves base of clay after masking at >50Hz. Moderate static. TEM 086 is higher than Rhomax and close to being conformable. D19 is very similar to 086. | 1.86 |
| W14 | 625.834 | 4608.492 | 1815 | MT OK. Thin and relatively resistive clay cap. TEM 103 is not conformable and much higher than Rhomax. R-21 fits Rhomax. | 1.64 |
| W15 | 602.853 | 4603.142 | 1756 | OK for mapping base of clay cap after masked >50 Hz. Small static. | 1.39 |
| W16 | 606.250 | 4600.220 | 1788 | MT is good. Large static. TEM 026 and 025 not conformable and much higher than Rhomax. | 2.49 |

| MT Station | UTM E km NAD27 | UTM N km NAD27 | Elev m | MT Station Processing Technical Summary | Static Mode Split |
|---|---|---|---|---|---|
| W17 | 608.664 | 4597.980 | 1711 | MT OK. TEM 031 not conformable and much higher resistivity. | 1.68 |
| W18 | 610.895 | 4595.973 | 1649 | MT OK. MT Rhoyx noisy from 0.7 to 5 Hz but smoothing seems OK based on phase. TEM 099 distant and not conformable. No MT split so not static shifted. | 1.00 |
| W19 | 597.462 | 4601.939 | 1768 | Good MT and small static. | 1.25 |
| W20 | 600.448 | 4599.056 | 1840 | MT OK. Large static. A point masked near 0.2 Hz. | 2.45 |
| W21 | 603.129 | 4594.495 | 1634 | MT OK. Moderate static. MT noisy from 0.25 to 1 Hz but smoothing seems to work. | 1.37 |
| W22 | 606.600 | 4590.738 | 1480 | MT OK. Moderate static. MT noisy from 1 to 4 Hz but smoothing seems to work. | 1.47 |

# APPENDIX B:
# Analysis of mineralogy and fluid inclusion data from Glass Mountain area temperature boreholes

# Attachment I

# CEC-500-2007-XXX-ATI

# Analysis of mineralogy and fluid inclusion data from Glass Mountain area temperature boreholes

This document is an attachment to a report funded by the California Energy Commission's Geothermal Resource Development Account (GRDA) Program. The GRDA Program did not fund this document, but the authors of the GRDA funded report have attached it as a supporting document.

The California Energy Commission wishes to thank the copyright holder, Calpine Corporation, for permission to republish this document in electronic format on the Energy Commission's website.

Please contact this document's author/publisher for additional information about the document.

Memorandum GM 19.03

UNOCAL 76

November 30, 1987

TO: Alex Schriener

FM: Daniel L. Carrier

RE: ANALYSIS OF MINERALOGY AND FLUID INCLUSION DATA FROM GLASS MOUNTAIN AREA TEMPERATURE BOREHOLES

## EXECUTIVE SUMMARY

A high-temperature hydrothermal system probably exists in the eastern half of the Medicine Lake Basin. This is the most significant conclusion of a study on mineralogy and fluid inclusion data obtained from boreholes drilled in and around ~~of~~ the Glass Mountain Federal Unit. Alteration that occurs on the northwestern margin of the Basin is old and not in thermal equilibrium with observed temperatures. Weak argillic alteration of uncertain age is found about 1-2 miles outside the Basin to the west and southwest.

The best evidence for an active system is observed in GMF 28-32 located on the eastern flank of Mt. Hoffman. The pattern of alteration in the temperature borehole varies systematically from zeolite-smectite (2480') to argillic (2680') to propylitic (3460' to 4500'). In addition, fluid inclusion data indicate that vein mineralogy at 4022' in GMF 28-32 was probably formed at temperatures of 464-500°F by hydrothermal fluids with a salinity of $\leq$20,000 ppm. The geothermal system possibly exists at shallower depths in the vicinity of boreholes GMF 44-33 and GMF 87-13, and is evidenced by the shallower occurrence of argillic alteration. However, the total depths of the two boreholes are not great enough to confirm the presence of propylitic alteration in those areas.

Mineralogical data indicate a 410 to 455°F geothermal system has existed as shallow as 1500-2500' near the northwest margin of the Medicine Lake Basin. However, fluid inclusion data from vein minerals in boreholes GMF 56-3 (1786' TD) and GMF 45-36 (4000' TD) indicate the geothermal system has declined. It is uncertain whether a high-temperature resource still exists in the area at depths greater than the two boreholes. Evidence for the hydrothermal event is characterized in GMF 56-3 by the occurrance at 1426' of chlorite-smectite clays that typically have formation temperatures of 390° to 455°F. The hydrothermal event in GMF 45-36 is evidenced by propylitic mineral assemblages at 2500' to 3430' and 3720' to 4000' TD. The upper propylitic assemblage in GMF 45-36 is sandwiched between two zones of argillic alteration, and is probably a relic of hydrothermal outflow. Fluid inclusion data suggest the outflow occurred at a temperature of at least 410° to 445°F.

Anomalous argillic alteration is observed in ML 36-28 at 1820' and ML 62-21 at 2115'. ML 36-28 is located about 2 miles outside the Medicine Lake Basin in the Little Glass Mountain Structural Zone. ML 62-21 is located about one mile outside the southwestern margin of the Basin. It is not clear if the observed alteration in either area is caused by localized hydrothermal activity, or if the alteration is linked by upflow or outflow to activity that has existed on the Basin margin.

## RECOMMENDATIONS

The results of this study lead to the following recommendations concerning potentially beneficial studies:

1. A detailed mineralogy and fluid inclusion study similar to this one should be completed for exploratory wells GMF 68-8 and GMF 17A-6. This study will contribute to the understanding of the Glass Mountain prospect, and will assist future exploration in the Glass Mountain Unit.

2. Mineralogy and fluid inclusion studies can be used in other prospects with intermediate temperature boreholes for locating areas of enhanced permeability. It is recommended that such studies be completed for the Lassen and Konocti prospects.

TABLE OF CONTENTS


| | Page |
|---|---|
| Executive Summary | 1 |
| Recommendations | 2 |
| Introduction | 3 |
| Methods and Data | 5 |
| Borehole Stratigraphy | 5 |
| Alteration Zoning and Mineralogy | 5 |
| General Stratigraphy and Alteration Patterns in Cross-Section | 9 |
| Fluid Inclusions | 9 |
| Case Study of Mineralogy, Fluid Inclusions and Measured Temperature Data for Three Boreholes | 13 |
| Conceptual Models | 18 |
| References | 21 |
| Appendix 1 | 22 |
| Appendix 2 | 39 |


## HYDROTHERMAL ALTERATION

### Introduction

Broadscale alteration zoning has been mapped in 24 temperature boreholes drilled in and around the Glass Mountain Federal Unit (Figure 1). The purpose of characterizing and outlining the alteration mineralogy observed in the boreholes is to help focus exploration efforts on the potentially hottest and most permeable areas. Fluid inclusion temperatures have also been measured on select samples to quantify the formation temperatures of the mineralogy.

Several factors affect the formation of hydrothermal minerals including temperature, pressure, primary lithology, permeability, fluid composition, and duration of the hydrothermal activity (Rose and Burt, 1979). The influence of primary lithology diminishes as formation temperatures are increased, and becomes insignificant when temperatures exceed 536°F (280°C) (Brown, 1978). In the case of Glass Mountain boreholes, the rock types drilled in the area range the full spectrum from basalts to rhyolites, and measured borehole temperatures are significantly less than 536°F. It is, therefore, likely primary lithology has some influence on the distribution of alteration observed in Glass Mountain boreholes. This possibly results in minor irregularities in the distribution of low-temperature alteration that are caused by lithologic differences rather than temperature or permeability.

Borehole depths must be considered when interpreting the mineralogy data in this report. The total drilled depths of the boreholes varied from 918'-4500'. This variability could

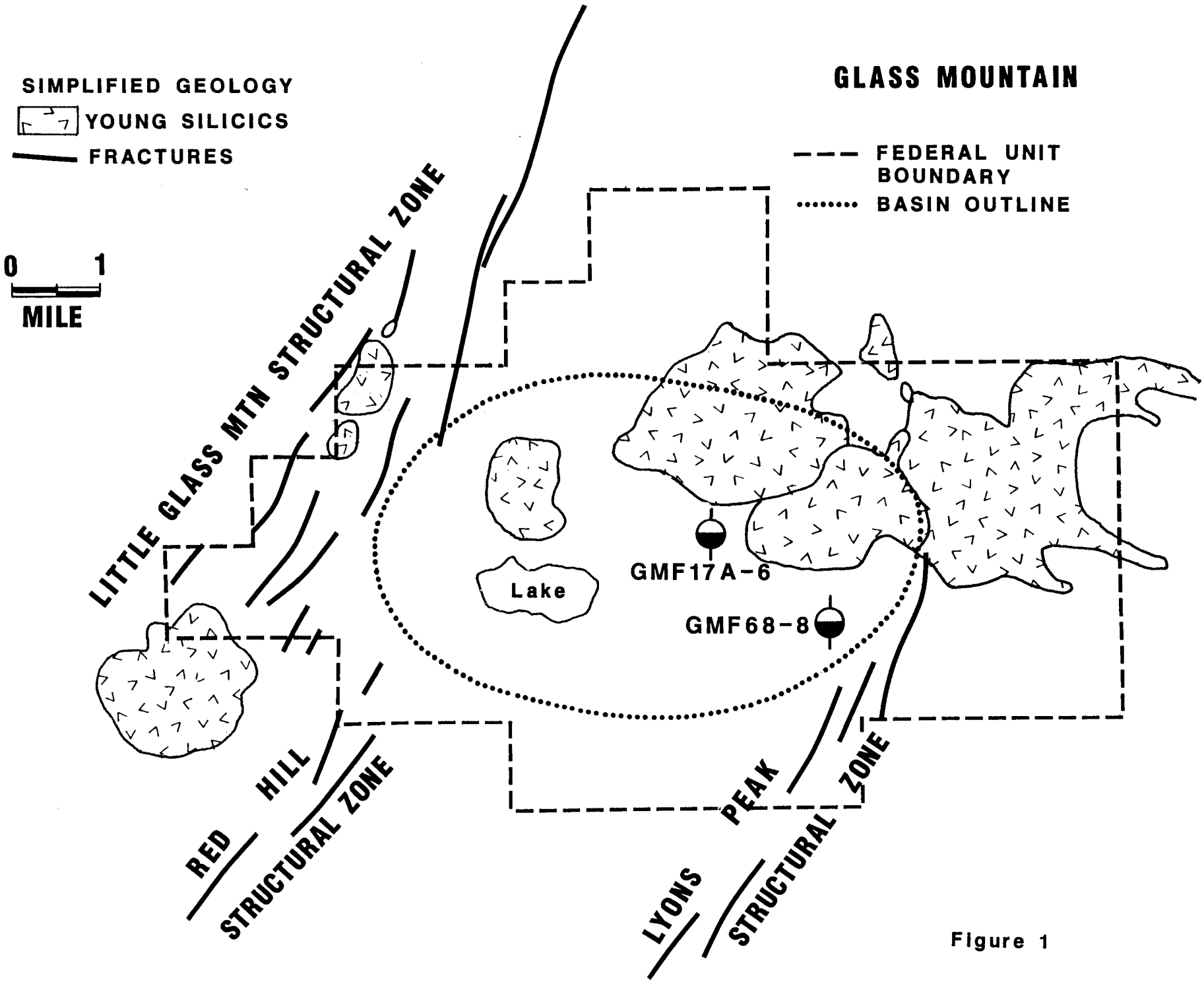

GLASS MOUNTAIN
SIMPLIFIED GEOLOGY
YOUNG SILICICS
FRACTURES
FEDERAL UNIT BOUNDARY
BASIN OUTLINE
0 1
MILE
LITTLE GLASS MTN STRUCTURAL ZONE
Lake
GMF17A-6
GMF68-8
RED HILL STRUCTURAL ZONE
LYONS PEAK STRUCTURAL ZONE

Figure 1

potentially result in the unequal evaluation of each borehole. Therefore, care has been exercised to insure that the absence of alteration zones in a shallow borehole is not the single criteria used to evaluate an area.

## Methods and Data

Rock samples from 24 boreholes were sent to Dr. Jeff Hulen at the University of Utah Research Institute for bulk x-ray defraction analysis (Appendix 1). Thin sections were prepared and examined for 17 boreholes. Core and cutting samples were relogged in detail for five boreholes (ML 29-1, GMF 28-32, GMF 45-36, GMF 17-6 and GMF 44-33), and the scanning sets for several boreholes were examined as well.

Twelve samples from five temperature boreholes were sent to Dr. T. James Reynolds of Fluid Inc. for fluid inclusion analysis. The five boreholes sampled were ML 36-28, ML 65-26, GMF 28-32, GMF 45-36 and GMF 56-3. GMF 28-32, GMF 45-36 and GMF 56-3 contained a total of five samples with usable fluid inclusions.

## Borehole Stratigraphy

Drilled stratigraphy broadly mirrors the surface geology mapped by Hausback (1984), although more lithologic detail is contained in the borehole data. Individual units of volcanic rock are difficult to correlate in Glass Mountain boreholes. Therefore, the rocks are classified into the following broad groups that are listed here in order of increasing age: bimodal rhyolites and basalts, shield-building mafics, flow-banded rhyolites and pyroclastics, and older mafics. In addition, the rock groups are sometimes discontinuous and the contacts between rock groups are not always sharp. For example, the transition the from flow-banded rhyolite to the overlying and underlying mafic rocks is marked by a variable zone of interlayered mafic flows and pumaceous lithic tuffs. Similarly, a possible silicic horizon occurs only in boreholes drilled in and around the Medicine Lake Basin. This silicic horizon is found at depths of 300' to 1000'; and possibly correlates with the 0.10 $\pm$ .01 m.y. old dacitic rocks mapped on the eastern flank of Glass Mountain (Mertzman, 1983). Geologic cross-sections that show some of these relationships will be presented in a later section. Additional stratigraphic analyses and correlation of rock types are needed before the rock groups can be further subdivided.

## Alteration Zoning and Mineralogy

Hydrothermal alteration is classified into three distinctive types or zones: zeolite-smectite, argillic, and propylitic. This classification is a modification of those presented by Rose and Burt (1979) and Kristmannsdottier (1982). The classification is based on observed mineralogy and does not

directly utilize temperature or lithologic data. The zeolite-smectite alteration zone is defined by the presence of either low-temperature zeolites, such as mordenite, stilbite and clinoptilolite, or of smectite as 3-15% (designated as "minor concentrations" by Hulen) of the XRD samples. The argillic alteration zone is characterized by the presence of hydrothermal quartz and 15-50% hydrothermal clay (designated as "major concentrations" by Hulen) in XRD samples. The clays used to characterize the zone include smectite, illite, chlorite, kaoline and the mixed layered clays illite-smectite and chlorite-smectite. Rocks are considered to be in the propylitic alteration zone when two of the following three secondary mineral groups are present: sodic plagioclase, chlorite and epidote or calcite (replacing feldspar). The distribution of alteration zones in each borehole is summarized in Appendix 2.

The occurrence of zeolite-smectite alteration is shallowest in boreholes located near or inside the Medicine Lake Basin. The distribution of the alteration is shown in Figure 2. Since the width of the intervals sampled for XRD analysis range from 200' to 700', the contours shown in the figure actually only outline broad trends in the data. The zeolite-smectite zone occurs at the shallowest depths in three boreholes located near the margins of the Basin, GMF 56-3, GMF 87-13 and GMF 44-33. A second trend towards shallow zeolite-smectite alteration is measured in boreholes located along the Little Glass Mountain Structural Zone. The alteration zone in this area occurs at depths of 800'-1500' in boreholes ML 57-11, ML 75-6, ML 36-28 and ML 14-23. Only four boreholes in Figure 2, ML 27-27 (southeast), ML 65-26 (south), ML1-81 (southwest), and ML2-81 (west), do not contain zeolite-smectite alteration. The only alteration in MLF 51-2, located in the very southwestern part of the area, is zeolite-smectite alteration and it occurs in the 900' to 1150' interval. The borehole is unaltered from 1150' to 1836' T.D.

Argillic alteration occurs in eight area boreholes including all five boreholes drilled in the Medicine Lake Basin (Figure 3). The alteration zone is shallowest in boreholes GMF 56-3, GMF 87-13 and GMF 44-33, and only two boreholes completely penetrate the zone, GMF 28-32 and GMF 45-36. The greatest thickness of argillic alteration is found in GMF 17-6, where at least 1000' of argillic alteration is observed before the borehole reaches total depth. Boreholes ML 62-21 and ML 36-28, located on the outside margin of the basin, are only weakly altered. The absence of argillic alteration in GMF 84-17, and ML 75-6 is possibly due to the shallow depths of the boreholes relative to the local trends in the argillic zone. Both boreholes are located in areas of shallow zeolite-smectite alteration and contain zeolite-smectite alteration to total depth.

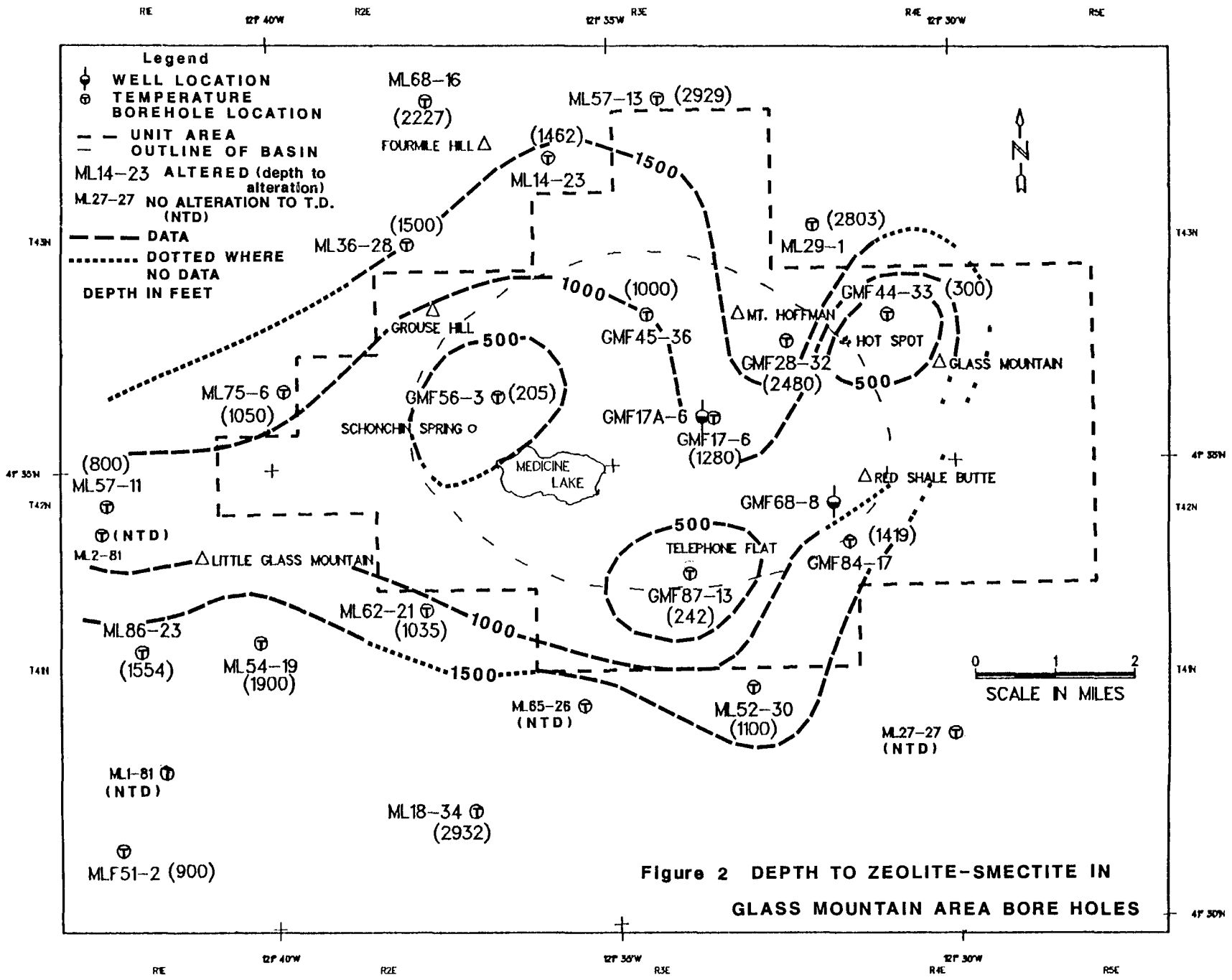



**Figure 2 DEPTH TO ZEOLITE-SMECTITE IN GLASS MOUNTAIN AREA BORE HOLES**

D.L.C 11/87

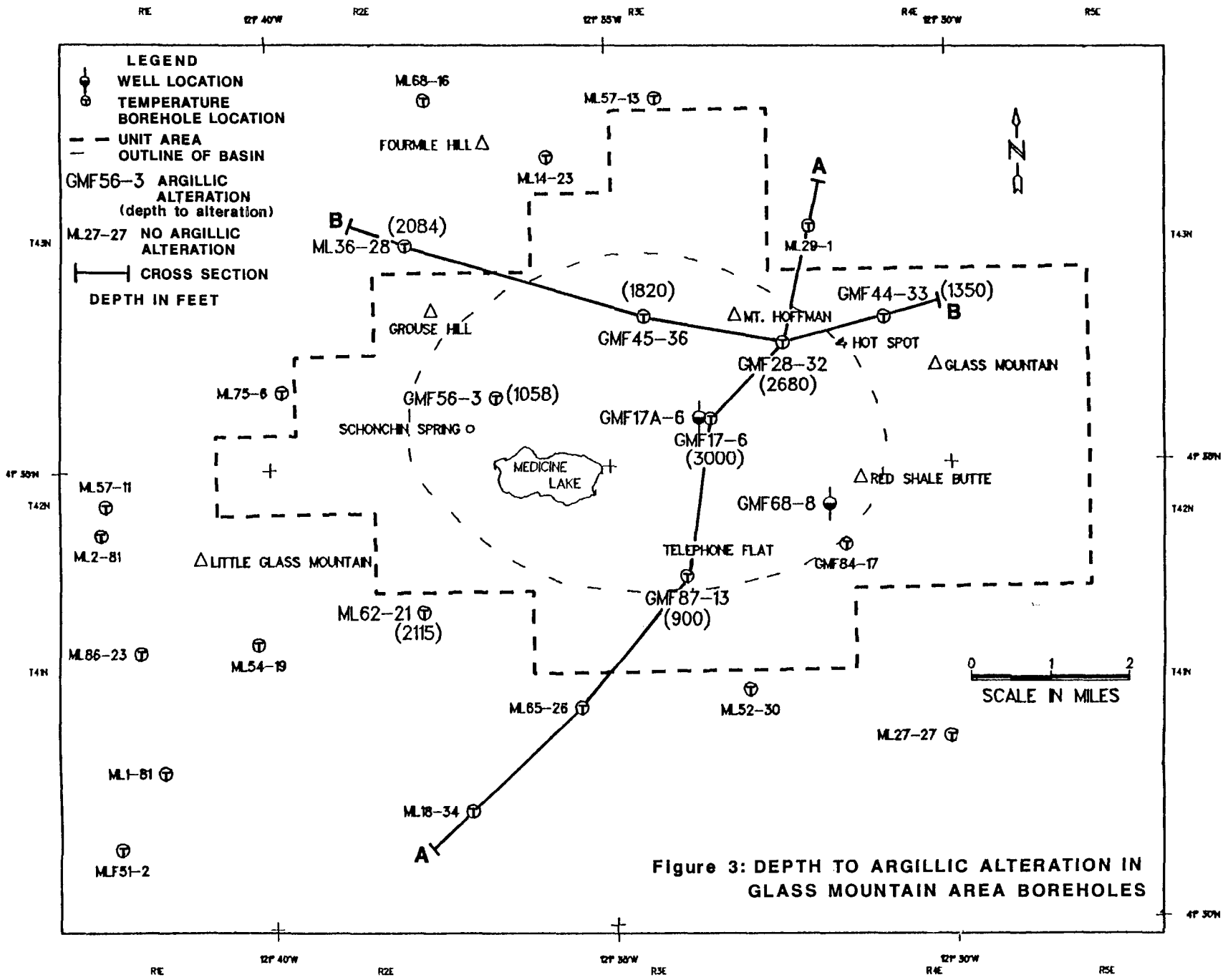



Figure 3: DEPTH TO ARGILLIC ALTERATION IN GLASS MOUNTAIN AREA BOREHOLES

D.L.C 11/87

GMF 28-32 and GMF 45-36 are the only two boreholes to contain propylitic alteration. The alteration zone occurs at a depth of 3460' in GMF 28-32 and 2500' in GMF 45-36. The boreholes are located within the Basin at its northern margin.

## General Stratigraphy and Alteration Patterns in Cross-Section

The pattern and intensity of alteration in the Glass Mountain KGRA appears to be generally independent of rock type. This is demonstrated in the two cross-sections shown in Figures 4 and 5 that integrate the alteration zoning and general geology observed in several of the deepest boreholes. Cross-section A-A' trends roughly north-south and extends through the eastern half of the Basin (Figure 3). Cross-section B-B' trends roughly east-west and includes boreholes located on the northern margin of the Basin. The alteration zones observed in the cross-sections are well developed, and transitions between zones are systematic and not marked by abrupt hiatuses.

Cross-section A-A' (Figure 4) clearly illustrates the trend of shallowing alteration with increased proximity to the Medicine Lake Basin. Argillic alteration is observed only in boreholes located in the basin, and is shallowest at the margins in GMF 28-32 and GMF 87-13. Propylitic alteration is observed only in one of the deepest boreholes, GMF 28-32.

Cross-section B-B' (Figure 5) is not as clear as A-A' in demonstrating a trend towards shallowing alteration with increased proximity to the Medicine Lake Basin. The shallowest argillic alteration is actually found just outside the basin in GMF 44-33, which is located near the Hot Spot. Argillic alteration is found in boreholes GMF 28-32, GMF 45-36, and ML 36-28 at depths that vary by only about 500'. Propylitic alteration is observed in boreholes GMF 45-36 and GMF 28-32. Borehole GMF 45-36 shows the pattern of reverse mineralization that is suggestive of lateral flow. The direction of lateral flow is unknown and is arbitrarily drawn.

## Fluid Inclusions

Fluid inclusion data are presented in Table 1 for samples from the three boreholes that contained minerals with measureable inclusions, GMF 45-36, GMF 28-32, and GMF 56-3. The characteristics of fluid inclusions and the several techniques and problems specific to fluid inclusions are detailed in Roedder (1972) and Bodnar and others (1985), and are only briefly discussed below. All the inclusions surveyed are of primary origin and formed during the growth of the secondary host crystals. The minerals surveyed include quartz, calcite, calcium zeolites (wairakite and laumontite), vein prehnite(?) and wallrock prehnite(?). The salinities observed varied from <1-2 wt% NaCl equivalent in the vein minerals. A salinity of <3.5 wt% NaCl equivalent was measured for the samples of

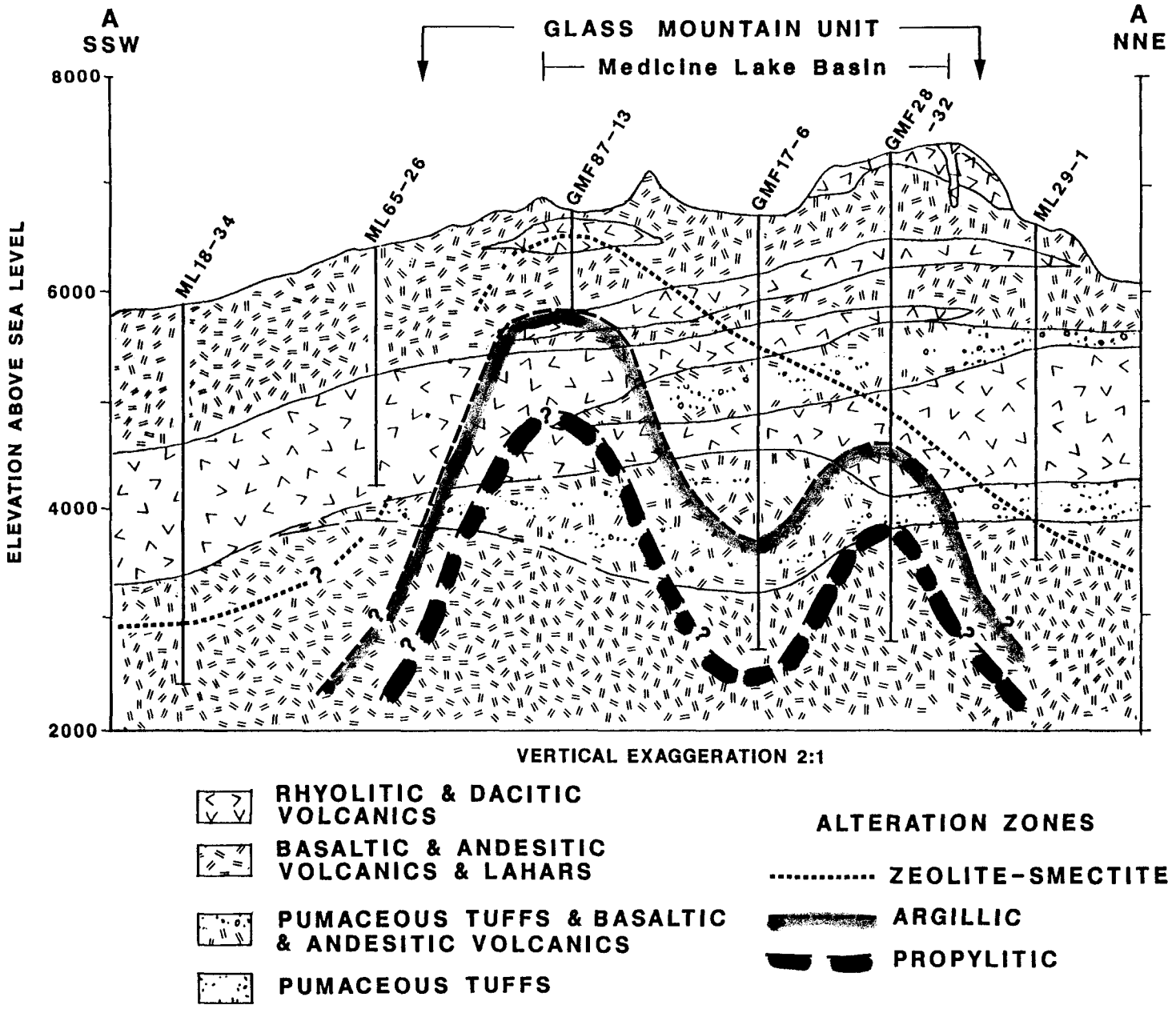



Figure 4. CROSS SECTION A-A INTERGRATING ALTERATION ZONING AND GENERAL GEOLOGY FOR SEVERAL BOREHOLES LOCATED IN THE EASTERN HALF OF THE GLASS MTN. AREA

D.L.C.11/87

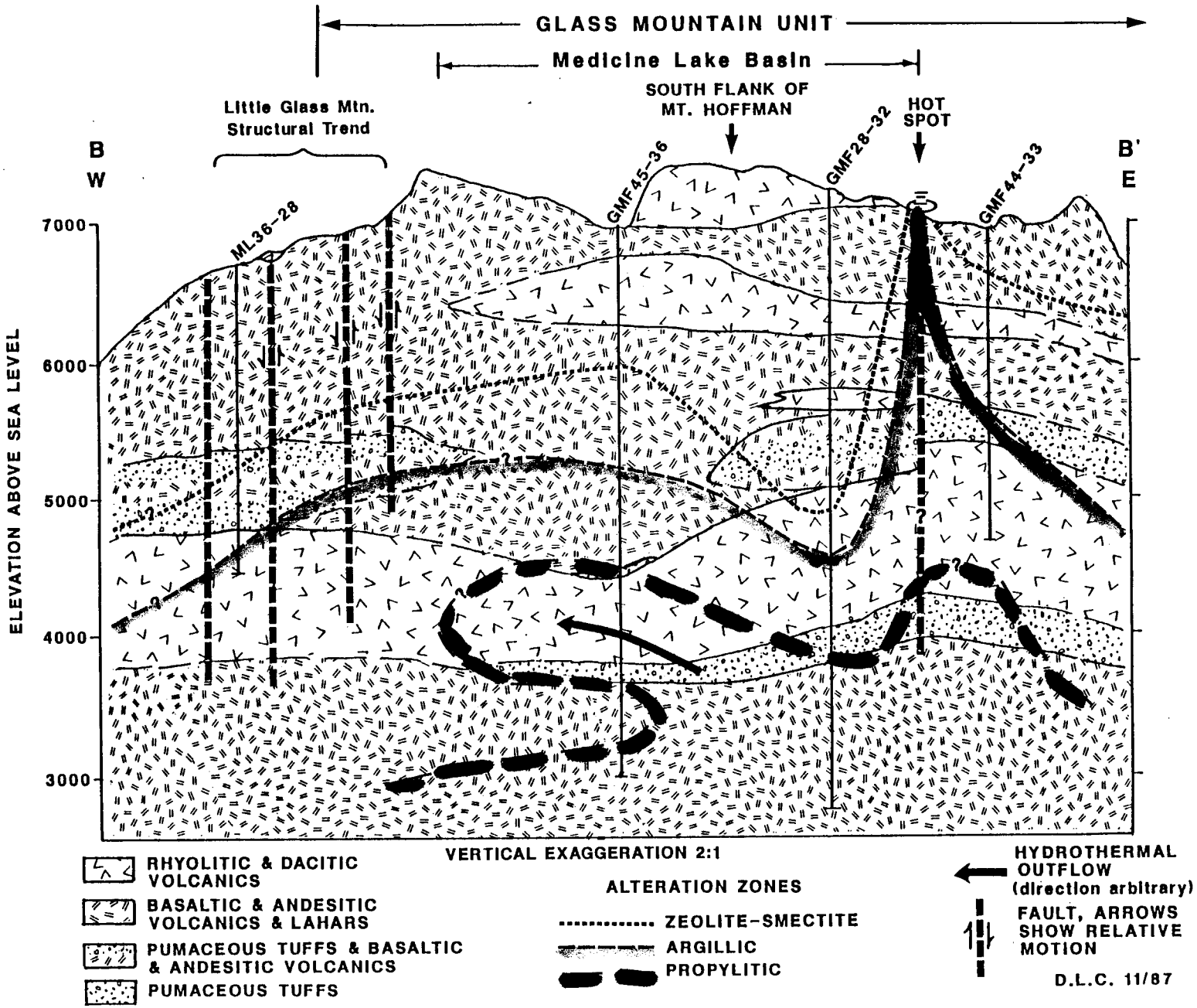



Figure 5: CROSS SECTION B-B' INTEGRATING ALTERATION ZONING AND GENERAL GEOLOGY FOR SEVERAL BOREHOLES LOCATED IN THE NORTHERN HALF OF THE GLASS MTN. AREA

Table 1 Fluid inclusion data obtained on samples from three temperature boreholes drilled in the Glass Mountain area Analysis were made by T James Reynolds of Fluid Inc

| Borehole | Sample Depth | No Inclusions Measured | Mineral* | Homogenization Temperature | Weight-% NaCl Equivalent |
|---|---|---|---|---|---|
| GMF 28-32 | 4022' | 12 | Calcite | 464-500°F | <1 5 |
| | | 8 | Quartz | 464-477°F | |
| GMF 45-36 | 2757' | 17 | Calcite | 410-446°F | <1 5 |
| | | 8 | Quartz | 437-446°F | <2 |
| | 3448' | 10 | Wallrock Prehnite | 347-365°F | <1 |
| | | 8 | Quartz | 338-356°F | <1 |
| | | 10 | Calcite | 320-347°F | <1 |
| | 3905 | 18 | Wallrock Prehnite | 347-365°F | <3 5 |
| | | 11 | Quartz | 356-374°F | <1 |
| | | 7 | Prehnite | 338-356°F | |
| | | 17 | Calcium Zeolite | 374-428°F | <1 |
| GMF 56-3 | 1723 5' | 4 | Calcium Zeolite I | 286-300°F | <3 |
| | | 3 | Calcium Zeolite II | 212-241°F | <3 |
| | | 5 | Quartz | 235-261°F | <1 5 |

*All minerals are vein minerals unless otherwise stated

wallrock prehnite found in GMF 45-36. A salinity of 1 wt% NaCl equivalent is approximately the same as a TDS of 10,000 ppm. The principal assumption made is that the salinity of an inclusion is due solely to dissolved sodium, potassium and calcium chlorides. However, if $CO_2$ is trapped in an inclusion, then measured salinities will be too high (Bodnar and others, 1985).

Fluid inclusion geothermometry is useful in determining the temperatures at which the secondary mineral formed (also called homogenization temperatures). These temperatures are best thought of as the minimum formation temperatures for the minerals. Because hydrothermal systems are dynamic, it is not appropriate for fluid inclusion temperature data to stand alone. Therefore, the geothermometry data are discussed below in conjunction with the petrological data. Measured temperature data are not integrated into this discussion due to an upcoming lease sale.

## Case Study of Mineralogy, and Fluid Inclusion Data for Three Boreholes

### GMF 28-32

Fluid inclusion temperatures and mineralogy correlate well for GMF 28-32, and indicate the likely occurrence of an active hydrothermal system in the vicinity of the borehole (Figure 6). The sequence of alteration in GMF 28-32 is straight forward and begins with the occurrence of zeolite-smectite alteration near a depth of 2480'. Argillic alteration begins in the borehole at 2680' and is followed by weak propylitic alteration at 3460'. The essential secondary minerals present at this depth are calcite, which is replacing plagioclase, and chlorite. The grade of alteration becomes stronger with depth and is distinguished by the first occurrence of epidote at 4330'. Other secondary minerals found in the borehole samples include prehnite, pyrite, wairakite and hematite.

Homogenization temperatures measured on a sample from 4022' in GFM 28-32 are 464-476°F for secondary quartz and 464-500°F for secondary calcite. These are the highest homogenization temperatures observed in samples from any of the boreholes and are reasonable temperatures for propylitic alteration. Salinities of $\leq$2 wt% NaCl equivalent (approximately 20,000 ppm) are measured in the inclusions and are possibly indicative of the local salinities expected for the active hydrothermal system.

### GMF 45-36

The integration of the fluid inclusion and mineralogical data sets indicate the observed alteration in GMF 45-36 is old, and that more than one hydrothermal event has probably occurred in

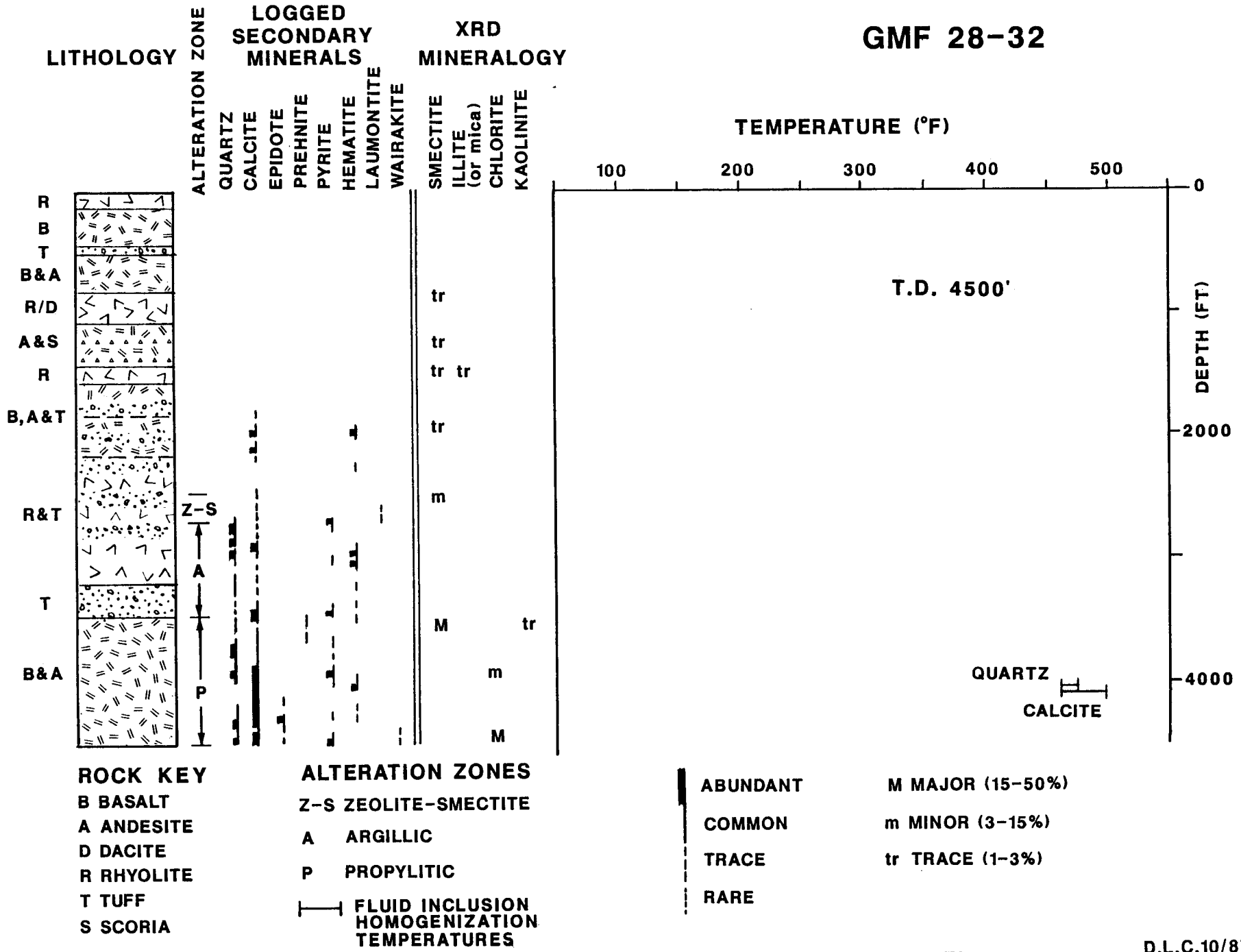



Figure 6

D.L.C.10/87

the area. The pattern of alteration in GMF 45-36 (Figure 7) suggests that high-temperature hydrothermal outflow has probably occurred in the area. Secondary mineralogy in the borehole is initially straight forward with the occurrence of the zeolite-smectite zone at 1000' and the argillic zone at 1820'. The distribution of secondary mineralogy becomes more complicated with depth, as evidenced by the occurrence of two layers of propylitic alteration at 2500' to 3430' and 3720' to 4000' T.D. It is likely that the propylitic alteration in the 2500' to 3430' interval is the result of hydrothermal outflow. The two propylitic alteration zones are separated by a thin zone of argillic alteration. The essential secondary minerals in the upper layer of propylitic alteration are chlorite, albite, and from 3220' to 3430', calcite. The essential secondary minerals in the lower layer are chlorite, calcite and epidote. Other secondary minerals that are present in either of the propylitic layers include prehnite, pyrite, hematite, laumontite and possible K-feldspar and wairakite.

The relationship between the fluid inclusion and mineralogical data is not straightforward. Homogenization temperatures of secondary minerals in the upper propylitic layer at 2757' are 410-445°F and in the sandwiched argillic zone at 3448' are 320-365°F. These homogenization temperatures are probably consistent with the observed pattern of propylitic to argillic alteration. However, temperatures measured on fluid inclusions obtained from 3905' are complex and probably not indicative of the bottom hole propylitic assemblage. Vein quartz, vein prehnite and wallrock prehnite are all in equilibrium with a hydrothermal event of 338-374°F and not the 392°F+ event needed to form the epidote in the host rocks (Bird and others, 1984). Sampled veins are also filled by a calcium zeolite (probably wairakite) with a higher homogenization temperature of 374-428°F. These data suggest that two hydrothermal events are probably recorded in the mineralogy of GMF 45-36 at 3905'. The first event probably caused the propylitic alteration of the host rocks. Later, as this hydrothermal system declined, secondary quartz and prehnite were formed in the fracture at 338-374°F. A second thermal event followed that resulted in the filling of the still open fractures by calcium zeolites at 374-428°F. The probable source of the thermal events is either a single growing system, in which temperature slowly increased over time, or two distinct hydrothermal systems.

GMF 56-3

Fluid inclusion data collected on vein minerals indicate the observed bulk-rock secondary mineralogy in GMF 56-3 is out of thermal equilibrium, and that the causative hydrothermal system has declined. Alteration in GMF 56-3 begins with zeolite-smectite alteration at a depth $\leq$205' and extends to 1031'. The argillic zone begins at 1031' and is the best developed sequence of argillic alteration (Figure 8) in any of

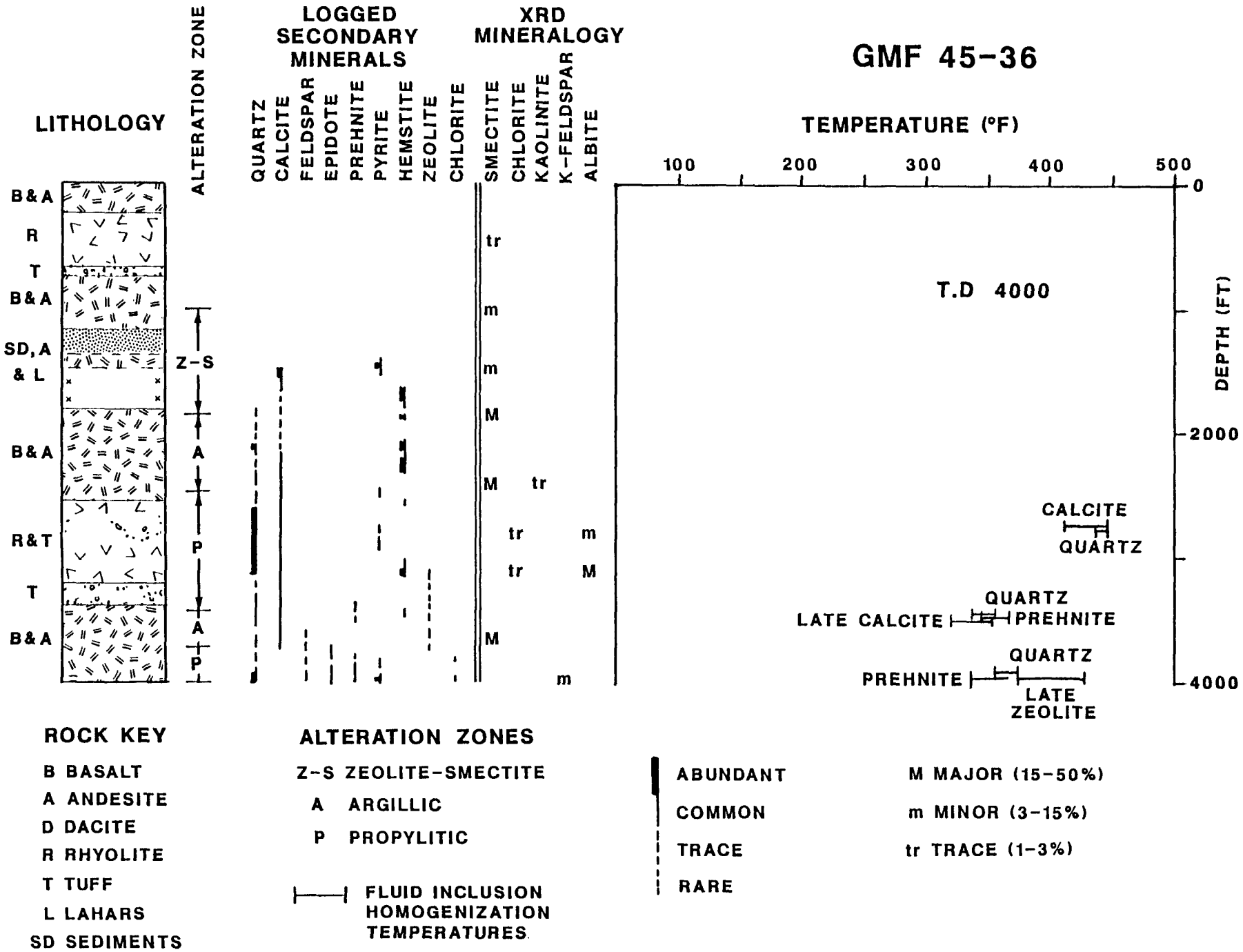

GMF 45-36
LITHOLOGY
ALTERATION ZONE
LOGGED SECONDARY MINERALS
XRD MINERALOGY
QUARTZ
CALCITE
FELDSPAR
EPIDOTE
PREHNITE
PYRITE
HEMSTITE
ZEOLITE
CHLORITE
SMECTITE
CHLORITE
KAOLINITE
K-FELDSPAR
ALBITE
B&A
R
T
B&A
SD, A & L
B&A
R&T
T
B&A
Z-S
A
P
A
P
tr
m
m
M
M
tr
tr
m
tr
M
M
m
TEMPERATURE (°F)
100
200
300
400
500
0
T.D 4000
DEPTH (FT)
2000
4000
CALCITE
QUARTZ
QUARTZ
LATE CALCITE
PREHNITE
QUARTZ
PREHNITE
LATE ZEOLITE
ROCK KEY
B BASALT
A ANDESITE
D DACITE
R RHYOLITE
T TUFF
L LAHARS
SD SEDIMENTS
ALTERATION ZONES
Z-S ZEOLITE-SMECTITE
A ARGILLIC
P PROPYLITIC
FLUID INCLUSION HOMOGENIZATION TEMPERATURES
ABUNDANT
COMMON
TRACE
RARE
M MAJOR (15-50%)
m MINOR (3-15%)
tr TRACE (1-3%)

Figure 7

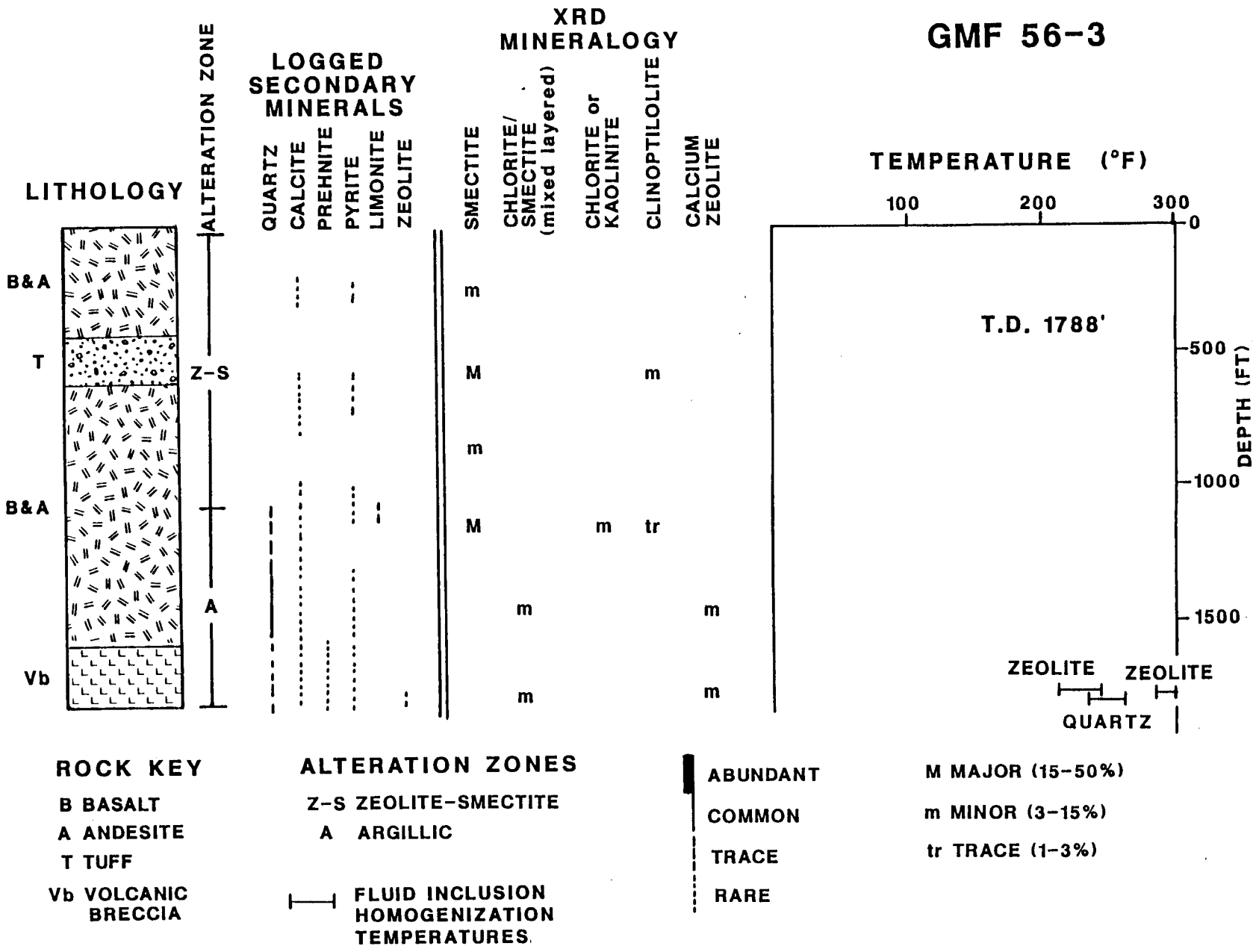



Figure 8

D.L.C 10/87

the area boreholes. Secondary mineralization in the alteration zone consists of the characteristic minerals quartz, smectite and intermittent kaolinite. As the depth of the borehole increases, the mineralogy evolves toward the higher temperature minerals of chlorite-smectite, and wairakite (1426'-1459' and 1727'-1760'). This assemblage is indicative of the higher temperature end of the argillic alteration zone (Brown, 1978; Bird and others, 1984), and is approaching propylitic alteration. Chlorite-smectite clays are mapped in Iceland by Kristmannsdottier (1982) as a separate alteration zone that occurs in mafic igneous rocks at temperatures of 390° to 455°F (200° to 230°C).

The fluid inclusion data from secondary vein minerals in GMF 56-3 record the decline of the hydrothermal system in two generations of inclusions. These fluid inclusions are observed in quartz and calcium zeolites that are contained in a sample collected at 1723.5'. Homogenization temperatures in these inclusions systematically vary from 285-300°F and 212-260°F, and are probably the remnants of a slowly cooling system. The latest vein-filling mineral is calcite, which is barren of inclusions and probably deposited at temperatures less than 212°F.

## CONCEPTUAL MODEL

Integrated mineralogy and fluid inclusion data are used to construct a conceptual model of the geothermal system in the Glass Mountain area. The completeness and accuracy of the model is limited by the variability in temperature borehole total depth. This variability makes borehole to borehole correlations difficult and incomplete, and probably impacts the observed distribution of argillic and propylitic alteration. However, this limitation not withstanding, it is believed that the general trends presented below are probably correct.

Four areas in the Glass Mountain Unit area are found to contain anomalous hydrothermal alteration. The locations of these four areas are shown in Figure 9. It is uncertain whether the alteration observed in each area is the result of a distinct hydrothermal event, or if any or all the areas outlined result from the same geothermal event. Nevertheless, the data do establish the occurrence of widespread hydrothermal activity in the area. The salient features of each area are discussed below.

### Area 1

A high-temperature geothermal system probably exists along the eastern margin of the Medicine Lake Basin. The most direct evidence for a system is contained in GMF 28-32 drilled along the eastern flanks of Mt. Hoffman. Fluid inclusion and mineralogical data are probably in thermal equilibrium, and

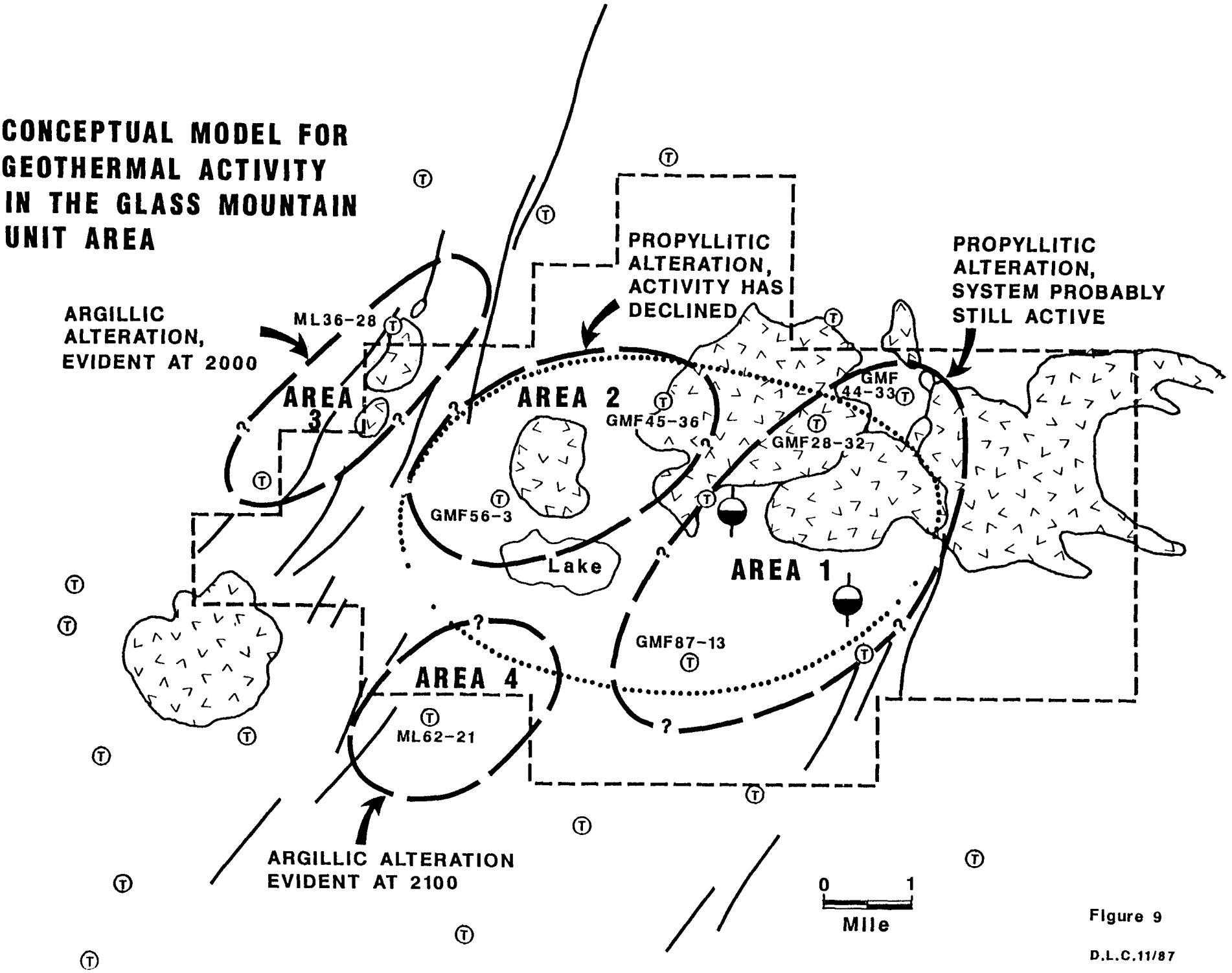



Figure 9

D.L.C.11/87

that hydrothermal fluids associated with the alteration probably have a salinity of $\leq$20,000 ppm. Argillic alteration is also found at 900' in GMF 87-13, located near Telephone Flats, and at 1350' in GMF 44-33, located near the Hot Spot. The argillic alteration in the two boreholes occurs at depths that are shallower than the same alteration in GMF 28-32 (2680'). Because GMF 87-13 and GMF 44-33 are shallow, no propylitic alteration is observed in the boreholes. Nevertheless, the available data suggest that the hydrothermal system is found at shallower depths at GMF 87-13 and GMF 44-33 than at GMF 28-32.

Area 2

High-temperature hydrothermal activity has occurred and possibly is still occurring along the western and northwestern margin of Medicine Lake Basin in the vicinity of GMF 56-3 (1788' TD) and GMF 45-36 (4000' TD). Estimated temperatures from bulk-rock secondary mineralogy and measured fluid inclusion temperatures are not in equilibrium and suggest that hydrothermal activity has declined in this area. It is uncertain whether it still exists at depths greater than the total depths of the boreholes.

Area 3

Moderate-temperature hydrothermal activity has and is possible still occurring in the vicinity of the Little Glass Mountain Structural Zone. The highest grade of alteration is observed at 2084' in GMF 36-28, and consists of weak argillic alteration. It is uncertain whether the alteration is the result of a distinct hydrothermal event associated with volcanic activity in the Little Glass Mountain Structural Zone, or if it is related to high-temperature hydrothermal activity in Area 2.

Area 4

Moderate-temperature hydrothermal activity has and is possibly still occurring in the Red Hill Structural Zone located about one mile southwest of the Medicine Lake Basin. The activity is characterized by weak argillic alteration observed at 2115' in ML 62-21. It is uncertain whether the alteration is the result of a local hydrothermal event, or possibly related to high-temperature activity in Area 1 or Area 2.

DLC/dis
4120I

## REFERENCES


Bird, D. K., P. Schiffman, W. A. Elders, A. E. Williams, and S. D. McDowell (1984), Calc-Silicate Mineralization in Active Geothermal Systems; Economic Geology, vol. 79, pp. 671-695.

Bodnar, R. J., T. J. Reynolds, and C. A. Kuehn (1985), Fluid Inclusion Systematics in Epithermal Systems, in Geology and Geochemistry of Epithermal Systems, Reviews in Econ. Geology, vol. 2, B. R. Berger and P. M. Bethke, Ed., pp. 73-97.

Brown, P. R. L. (1978), Hydrothermal Alteration in Active Geothermal Fields, Annual Review of Planetary Science, vol. 6, pp. 229-50.

Hausback, B. P. (1984), Surficial geology of the Medicine Lake Highland, in house report, Unocal Geothermal Division, 12 p.

Kristmannsdottier, H. (1982), Alteration in the IRDP Drill Hole Compared with Other Drill Holes in Iceland, Journ. Geophysical Res., v. 87, pp. 6525-6531.

Mertzman, S. A. (1983), An Addendum to "K-Ar Results for Silicic Volcanics from the Medicine Lake Highland, Northeastern California -- A Summary, ISOCRON/WEST, No. 38, Dec., pp. 3-5.

Roedder, E. (1972), Composition of Fluid Inclusions, in Data Geochemistry, Sixth Edition, M. Fleischer, Tech. ed., 1972, 164 p.

Rose, A. W. and D. M. Burt (1979), Hydrothermal Alteration, in Geochemistry of Hydrothermal Ore Deposits, H. L. Barnes, ed., Second Edition, pp. 173-235.

APPENDIX 1

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
420 CHIPETA WAY, SUITE 120
SALT LAKE CITY, UTAH 84108
TELEPHONE 801-581-5283

April 16, 1984

Alex Schriener
Area Geologist
Union Geothermal Division
Union Oil Company of California
2099 Range Avenue
Santa Rosa, CA 95406

Dear Alex:

The 34 geochemical pulp samples you submitted earlier this year have been mineralogically analyzed by qualitative X-ray diffraction (XRD). Preliminary results for 13 bulk samples, and for clay fractions extracted from seven of these, were reported to you in my letter of March 5. The present report documents analyses for the entire sample suite, and briefly discusses implications of these analyses for geothermal exploration.

Bulk samples can be grouped broadly into two categories: 1) those dominated by plagioclase and 2) those containing sanidine and cristobalite with minor tridymite and a trace of quartz. These two sample types probably correspond, respectively, to intermediate to mafic volcanic rocks and felsic volcanic rocks.

Plagioclase in type 1 rocks is a variety more calcic than albite, probably andesine or labradorite; it may be accompanied by trace to minor clinopyroxene and apatite, but the X-ray signatures of these phases, if present, are obscured or concealed by the strong, numerous, crowded peaks of the overwhelmingly dominant plagioclase; petrographic examination is suggested for definite identification. Ilmenite, pyrite or marcasite and hematite are other probable trace constituents of many plagioclase-rich samples.

Cristobalite-sanidine rocks are probably rich in devitrifed felsic glass. In several of these rocks, such as well no. 3, 750-800', devitrification may not have proceeded to completion; a prominent, broad glass "hump" is apparent between about 18 and 34°2θ. Alternatively, but less likely, the "hump" could reflect the presence of opal.

Zeolites occur only in wells 1 and 2. In well 1, mordenite is a major constituent of the sample spanning 1900-1950'. In well number 2, zeolites are

zoned with depth; clinoptilolite occurring above 1145' and analcime or wairakite (too little of this phase for a definite identification) below this footage.

Clay minerals occur in all wells, but are most abundant in wells 1 and (particularly) 2. Smectite, the most common, is found in 16 of the 34 bulk samples; it is a major component of three. With a basal spacing of about 14Å, , the smectite probably contains calcium and/or (less likely) magnesium as the principal interlayer cation(s). Illite occurs only in well no. 1; at a depth of 1900' in this well it is accompanied by a trace of randomly-ordered, mixed-layer illite-smectite. Chlorite or kaolinite occur in two samples--one each in wells 2 and 4.

Well number 2 displays a distinct layer silicate zoning which mirrors the zoning of coexisting zeolites. Smectite occurs in the four samples above 1145'; in two of these samples it is accompanied by clinoptilolite. The two samples below 1145' contain conspicuous mixed-layer chlorite-smectite--an ordered variety with about 55% chlorite (Reynolds, 1980). This phase is accompanied in both samples by analcime or wairakite.

Of the five wells investigated, number 2 would appear to be the most encouraging for discovery of a concealed geothermal resource. Its well-developed zeolite and clay mineral zoning may indicate progressively higher-temperature, hydrothermal fluid circulation with increasing depth. Ordered, mixed-layer clays such as those of well 2 almost always develop at relatively high temperatures under conditions of deep diagenesis or hydrothermal alteration (Dunoyer de Segonzac, 1970). Mixed-layer, ordered chlorite-smectites were found in cuttings above productive reservoir at the Tiwi system, Philippines (UURI/ESL reports to Thomas Powell; Nov. 21, 1983 and Feb. 14, 1984), and in cuttings from your Geysers well KC88-24 (UURI/ESL report to Barbara Gallinatti; April 2, 1984), strengthening speculation that an active geothermal system could be present below the sampled depths of well 2. In research well Y-1 at Yellowstone (Honda and Muffler, 1970) clinoptilolite in less altered, high-level rocks gives way to analcime in deeper, more highly altered rocks; this zeolite zoning sequence is very similar to that observed in well 2. Of course, the alteration of well 2 could be entirely paleohydrothermal, so all other downhole data should be compared with the alteration assemblages to determine the probability of a concealed thermal resource at this site.

Thank you very much for submitting these rocks for X-ray analysis. I realize you've had to wait quite a while for the results, and appreciate your patience. The analyses are intriguing; I hope they enable you to bring in a new field.

Sincerely yours,

Jeffrey B. Hulen
Geologist

JBH/jp

## REFERENCES

Dunoyer de Segonzac, 1970, The transformation of clay minerals during diagenesis and low-grade metamorphism--a review: Sedimentology, vol. 15, p. 281-346.

Honda, S., and Muffler, L. J. P., 1970, Hydrothermal alteration in core from research drill hole Y-1, Upper Geyser Basin, Yellowstone National Park, Wyoming: American Mineralogist, vol. 55, p. 1714-1737.

Reynolds, R. C., 1980, Interstratified clay minerals in Brindley, G. W., and Brown, G., eds., Crystal structures of clay minerals and their X-ray identification: London, Mineralogical Soc. Mon. 5, p. 411-438.

GMF 56-3

WELL NO 2
BULK CUTTINGS

GMF 56-3

**MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓**

| SAMPLE NO | QUARTZ | CRISTOBALITE | TRIDYMITE | K-FELDSPAR | PLAGIOCLASE | HEMATITE | ILMENITE | PYRITE OR MARCASITE | GOETHITE | ILLITE | SMECTITE | CHLORITE OR KAOLINITE | MIXED-LAYER CHLOR-SMEC | MIXED-LAYER ILLITE-SMEC | CLINOPTILOLITE | ANALCIME OR WAIRAKITE | CALCITE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 205-301' | | | | | MM | | | Tr? | Tr? | Tr? | | | m | | | | | | | | |
| 506-562' | | | | | MM | | | | Tr? | | | | M | | | | | m | | | |
| 787-886 | | | | | MM | | | | Tr? | | | | m | | | | | | | | |
| 1110-1145' | m | | | | MM | | ? | | m? | | | | M | m | | | | Tr? | | | |
| 1426-1459' | m | | | | MM | | ? | | m? | | | | | | m | | | | m | | m |
| 1727-1760' | m | | | | MM | | m | | | | | | | | m | | | | m | | |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

TABLE 2

WELL NO 2

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

ML 51-2

WELL No. 3
BULK CUTTINGS

ML 51-2
SAMPLE NO.

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓

| SAMPLE NO. | QUARTZ | CRISTOBALITE | TRIDYMITE | K-FELDSPAR | PLAGIOCLASE | HEMATITE | ILMENITE | PYRITE OR MARCASITE | ILLITE | SMECTITE | CHLORITE OR KAOLINITE | MIXED-LAYER CHLORITE-SMEC | MIXED-LAYER ILLITE-SMEC. | NOTES/OTHER PHASES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 150-200' | TR | M | TR | | M | | | | | | | | | |
| 500-550' | TR | M | M | | M | | | | | | | | | |
| 750-800' | | M | TR | | M | | | | | | | | | PROBABLY ABUNDANT GLASS |
| 900-950' | m | | | | | MM | | | | M | | | | |
| 1150-1200' | | | | | | MM | – | | TR? | | | | | |
| 1500-1550' | | | | | | MM | | TR? | TR? | | | | | |
| 1800-1840' | | | | | | MM | | TR? | TR? | | | | | |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

TABLE 3

WELL No. 3

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

ML 52-30

WELL No 4
BULK CUTTINGS

ML 52-30

SAMPLE NO

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓

| SAMPLE NO | QUARTZ | CRISTOBALITE | TRIDYMITE | K-FELDSPAR | PLAGIOCLASE | HEMATITE | ILMENITE | PYRITE OR MARCASITE | ILLITE | SMECTITE | CHLORITE OR KAOLINITE | MIXED-LAYER CHLORITE-SMEC | MIXED-LAYER ILLITE-SMEC | | | | | | | | NOTES/ OTHER PHASES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 250-300 | | | | | MM | | m | | | | TR | TR | | | | | | | | | |
| 500-550' | | | | | M | | | | | | | | | | | | | | | | PROBABLY ABUNDANT GLASS |
| 800-850' | | M | | m | M | | TR? | | | | | | | | | | | | | | |
| 1100-1150' | | | | | MM | | | | | | m | | | | | | | | | | |
| 1450-1500 | TR | M | TR | M | M | | | | | | m | | | | | | | | | | |
| 1700-1750 | | M | TR | M | TR? | | | | | | TR? | | | | | | | | | | |
| 1900-1950 | TR | M | m | M | | | | | | | | | | | | | | | | | |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

TABLE 4

WELL No 4

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

ML 54-19

WELL No 5
BULK CUTTINGS

**ML-54-19**

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

TABLE 5

WELL NO. 5

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ☑

| SAMPLE NO | QUARTZ | CRISTOBALITE | TRIDYMITE | K-FELDSPAR | PLAGIOCLASE | HEMATITE | ILMENITE | PYRITE OR MARCASITE | ILLITE | SMECTITE | CHLORITE OR KAOLINITE | MIXED-LAYER CHLORITE-SMEC | MIXED-LAYER ILLITE-SMECTITE | NOTES/OTHER PHASES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 150-200' | | | | | MM | | | Tr? | | | | | | |
| 500-550 | | | | | MM | | | | | | | | | |
| 850-900' | | | | | MM | m? | | | | | | | | ALSO UNKNOWN 7.44Å PHASE → |
| 1300-1350' | | | | | MM | m | | | | | | | | PROBABLE ABUNDANT GLASS |
| 1500-1550' | | | | | MM | Tr? | | | Tr? | | | | | |
| 1550-1600 | | | | | MM | | | Tr? | | | | | | |
| 1900-1950' | | | | | MM | | | Tr? | m | | | | | |
| 2150-2200' | | | | | MM | | | | m | | | | | |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

WELL Nos 6 & 7
BULK CUTTINGS

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓

| SAMPLE NO | QUARTZ | CRISTOBALITE | TRIDYMITE | K-FELDSPAR | PLAGIOCLASE | HEMATITE | ILMENITE | PYRITE | ILLITE | SMECTITE | CHLORITE OR KAOLINITE | MIXED-LAYER CHLOR-SMEC | MIXED-LAYER ILLITE-SMEC | NOTES/OTHER PHASES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WELL No. 6 | | | | | | | | | | | | | | |
| ML 75-6 | | | | | | | | | | | | | | |
| 350-400 | | | | | MM | TR? | | | | | | | | |
| 600-650 | | | | | MM | | | TR? | | | | | | |
| 800-850 | | | | | MM | m | TR | | | | | | | |
| 1050-1100 | | | | | MM | TR? | TR | | | m | | | | |
| 1450-1500 | m | | | TR? | m | | | | | m | | | | ABUNDANT GLASS |
| 1750-1800 | TR | | | | MM | | | | | m | | | | |
| 1950-2000' | | | | | MM | | | | | m | | | | |
| ML 7-81 | | | | | | | | | | | | | | |
| WELL No. 7 | | | | | | | | | | | | | | |
| 700-730' | TR | | m | | m? | MM | | | | TR | | | | |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

WELL NOS 8, 10, 11
BULK CUTTINGS
(WELL NO. 9 ON FOLLOWING PAGE)

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓

| SAMPLE NO | QUARTZ | CRISTOBALITE | TRIDYMITE | K-FELDSPAR | PLAGIOCLASE | HEMATITE | ILMENITE | PYRITE | ILLITE | SMECTITE | CHLORITE | MIXED-LAYER ILLITE-SMEC | MIXED-LAYER CHLOR.-SMEC | CLINOPTILOL | ANALCIME | NOTES/ OTHER PHASES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GME 57-13 | | | | | | | | | | | | | | | | |
| No 8 242-270 | | M | | | M | m | | | | m | | | | | | |
| 461-487' | | | | | | M | | M | | m | | | | m | | |
| 633-661 | | | | | | MM | | m | | M | | | | m | | |
| 825-851' | | | | | | MM | | m | TR? | M | | | | TR | | |
| GME 44-37 | | | | | | | | | | | | | | | | |
| No 10 300-390' | | | | | | MM | | m | | m | | | | | | |
| 570-630 | | M | | | M | m | | | *TR? | TR | | | | | | PROBABLY ABUNDANT GLASS |
| 870-930' | | | | | | M | | | | TR | | | | | | " |
| 1170-1230' | | | | | | M | | | | m | | | | | | " |
| 1440-1470 | m | | | | TR | M | | | | | | | | | | " |
| 1710-1740 | M | m | | | M | | | | | | TR? | | | | | |
| 1920-1950 | M | m | | | M | | | | | | | | | | | |
| 2200-2230' | M | m | | | M | | | m | | m | | | | | | |
| ML 57-11 | | | | | | | | | | | | | | | | |
| No. 11 300-350 | | | | | MM | | | | | | | | | | | |
| 550-600 | | | | | MM | | | | | | | | | | | |
| 800-850 | | | | | MM | TR? | TR? | | | m | | | | | | |
| 1100-1150' | | | | | MM | | | | | m | | | | | | |
| 1450-1500' | | | | | MM | | | | | m | | | | | | |
| 1850-1900 | | | | | MM | | | | | m | | TR? | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | *OR MARCASITE |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

WELL No. 9
BULK CUTTINGS

GMF 17-6

**MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓**

| SAMPLE NO. | QUARTZ | CRISTOBALITE | TRIDYMITE | K-FELDSPAR | PLAGIOCLASE | HEMATITE | ILMENITE | PYRITE | ILLITE | SMECTITE | CHLORITE | MIXED-LAYER ILLITE-SMEC. | MIXED-LAYER CHLOR.-SMEC. | CLINOPTILOL. | ANALCIME | NOTES/ OTHER PHASES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 270-330′ | | | | | MM | TR | TR | | | TR | | | | | | |
| 420-470′ | | | | TR? | MM | TR | TR | | | TR | | | | | | |
| 720-780′ | | M | TR | M | | | | | | TR | | | | | | |
| 960-1020′ | | | | | MM | | TR | | | TR | | | | | | |
| 1260-1380′ | | | | | MM | | | | | m | | | | m | m | |
| 1770-1860′ | | | | | MM | | TR | | | m | | | | | | |
| 2280-2300′ | | | | | MM | | | | | m | | | | | | |
| 2620-2680′ | | | | | MM | TR | | | | m | | | | | | |
| 3040-3100′ | | | | | MM | m | TR | | | m | | | | | | |
| 3400-3460′ | M | | | m? | MM | | | ǂTR? | | TR | m | | | | | |
| 3460-3670′ | m | | | | MM | | | | | m | | | m | | | |
| 3940-3990′ | m | | | | MM | | TR | | | m | TR* | | | | | ǂ OR MARCASITE<br>* OR KAOLINITE |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

WELL Nos. 12 & 13
BULK CUTTINGS

& ML65-26

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓

| SAMPLE NO. | QUARTZ | CRISTOBALITE | TRIDYMITE | K-FELDSPAR | PLAGIOCLASE | HEMATITE | ILMENITE | PYRITE | ILLITE OR MICA | SMECTITE | MIXED-LAYER ILLITE-SMEC. | MIXED-LAYER CHLOR.-SMEC. | | STILBITE | | | | | OTHER PHASES / NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WELL No. 12 | | | | | | | | | | | | | | | | | | | |
| 450-500' | | | | | MM | | | | | | | | | | | | | | |
| 750-800' | | | | | MM | m | | | | | | | | | | | | | |
| 1050-1100' | | | | | MM | | Tr? | | | | | | | | | | | | |
| 1350-1400' | Tr | M | m | M | | | | | | | | | | | | | | | |
| 1600-1650' | Tr | M | Tr | M | | | | | | | | | | | | | | | |
| 1850-1900' | | M | m | M | | | | | m | | | | | | | | | | |
| 2100-2150' | | m | M | M | | | | | Tr? | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| GMF 84-17 | | | | | | | | | | | | | | | | | | | |
| WELL No. 13 | | | | | | | | | | | | | | | | | | | |
| 304-336' | | | | | M | | | | | | | | | | | | | | PROBABLY ABUNDANT GLASS |
| 564-605' | | | | | MM | | | | | | | | | | | | | | |
| 829-863' | | M | | M | M | | | | | | | | | | | | | | |
| 1178-1208' | | | | | MM | | | | | Tr | | | | | | | | | |
| 1419-1448' | | | | | M | m | | | | M | | | | m | | | | | |
| 1588-1617' | | M | | M | | | | | | m | | | | | | | | | |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

* MAY INCLUDE OTHER AMORPHOUS PHASES SUCH AS OPAL.

| SAMPLE NO | MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓ | | | | | | | | | | | | | | | | | | | | | | | OTHER PHASES POSSIBLY PRESENT IN TRACE TO MINOR AM'TS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QUARTZ | CRISTOBAL. | TRIDYMITE | K-FELDSP | PLAGIOCL. | ILMENITE | HEMATITE | MAGNETITE | SMECTITE | ILLITE &/OR MICA | CHLORITE | KAOLIN &/OR SERPENTINE | CALCITE | GLASS * | ANALCIME OR WAIRAKITE | CLINOPTILOL | OPAL-CT | | | | | | | |
| WELL 62-21 | | | | | | | | | | | | | | | | | | | | | | | | |
| 530' | | | | | MM | <m | <m | | <m | | | | | m? | | | | | | | | | | CPX OPX AP |
| 1035' | | | | | MM | | <m | | M | | | | | m? | | <m | <m? | | | | | | | |
| 1700' | | | | | MM | | | | M | | | | <m | m? | | | | | | | | | | CPX AP |
| 1973' | | | | | MM | | <m | <m? | M | | | | <m? | m? | | <m | | | | | | | | CPX, AP |
| 2132' | | | | | MM | <m? | <m | | M | | | | | m? | | | | | | | | | | CPX, AP |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| WELL 68-16 | | | | | | | | | | ✓ | | | | ✓ | | | | | | | | | | |
| 508' | | M | | MM | m | | <m | | | | | | | | | | | | | | | | | |
| 1039' | | M | | MM | m | | <m | | <m? | | | | | | | | | | | | | | | |
| 1338' | | | | | m | | | | | | | | | MM | | | | | | | | | | |
| 1740' | | | | | M | | | | <m | | | | | M | | | | | | | | | | CPX |
| 1857' | | | | | m | | | | <m | <m? | | | | MM | | | | | | | | | | |
| 2227' | | | | | MM | | <m? | | m | | | | | m? | | | | | | | | | | CPX, AP |
| 2599' | | MM | m | M | | | <m | | | | | | | | | | | | | | | | | |
| 2936' | | MM | | M | | | <m | | <m | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| WELL 86-23 | | | | | | | | | | | | | | | | | | | | | | | | |
| 694' | | | | | MM | | <m | | <m | | | | | m? | | | | | | | | | | CPX, AP |
| 1085' | | | | | MM | | <m | | <m | | | | | m? | | | | | | | | | | CPX OPX, AP |
| 1554' | | | | | MM | | m | | m | | | | | m? | | | | | | | | | | CPX AP |
| 2258' | | | | | MM | | <m | | <m | | | | | m? | | | | | | | | | | CPX, AP |
| 3157' | | | | | MM | | <m | | M | | | | | m? | | | | | | | | | | CPX, OPX, AP |
| 3497' | | | | | M | | | | M | | | | | m? | <m | | | | | | | | | CPX, AP |

MM = PREDOMINANT M = MAJOR m = MINOR <m = <5WT.% ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

* MAY INCLUDE OTHER AMORPHOUS PHASES SUCH AS OPAL

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓

| SAMPLE NO | QUARTZ | CRISTOBAL | TRIDYMITE | K-FELDSP. | PLAGIOCL | ILMENITE | HEMATITE | MAGNET | SMECTITE | ILLITE &/OR MICA | CHLORITE | KAOLIN OR SERPENTINE | CALCITE | GLASS * | PYRITE | OTHER PHASES POSSIBLY PRESENT IN TRACE TO MINOR, AM'TS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WELL 45-36 | | | | | | | | | | | | | | | | |
| 100' | | | | | MM | <m | <m | | | | | | m? | | | CPX OPX, AP |
| 480' | m | M | m | MM | | | | | <m | | | | | | | |
| 1000' | | | | | MM | | <m | | m | | | | m? | | | CPX OPX AP |
| 1470' | | | | | MM | <m | <m | | m | | | | m? | | | CPX OPX, AP |
| 1860' | | | | | MM | <m | m | | M | | | | m? | | | AP |
| 2390' | | | | | MM | <m | <m | | M | | <m | | m? | | | AP |
| 2780 | M | | | M | m | | <m? | | | <m | | | | <m | | |
| 3100' | M | | | M | M | | <m? | | | <m | | | | | | NOTE PLAGIOCLASE IS PROBABLY ALBITE |
| 3600' | m | | | | MM | <m? | | | M | | | | m? | | | CPX AP |
| 4000' | m | | | m | MM | | | <m | | | m | | m? | | | AMPH |
| | | | | | | | | | | | | | | | | |
| WELL 57-13 | | | | | | | ✓ | | | | | | | | | |
| 781' | | | | | <m | | | | | | | | MM | | | CPX |
| 1423' | | | | | m | | | | | | | | MM | | | |
| 1637' | | | | | <m | | | | | | | | MM | | | |
| 2079' | m | <m | M | MM | | | <m | | <m | <m | | | | | | |
| 2426' | | | | | | | | | <m | | | | MM | | | |
| 2929' | | | | | MM | | | | M | | | | m? | | | CPX |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

MM = PREDOMINANT  M = MAJOR  m = MINOR  <m = <5 WT.%  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

* MAY INCLUDE OTHER AMORPHOUS PHASES SUCH AS OPAL.

| SAMPLE NO. | MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ☑ | | | | | | | | | | | | | | | | | | | | | | | OTHER PHASES POSSIBLY PRESENT IN TRACE TO MINOR AMOUNTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QUARTZ | CRISTOBAL. | TRIDYMITE | K-FELDSP. | PLAGIOCL. | ILMENITE | HEMATITE | MAGNETITE | SMECTITE | ILLITE #/OR MICA | CHLORITE | KAOLIN #/OR SERPENTINE | CALCITE | GLASS * | ANALCIME OR WAIRAKITE | PYRITE | | | | | | | | |
| WELL 28-32 | | | | | | | | | | | | | | | | | | | | | | | | |
| 440' | | M | m | MM | <m? | | <m | | | | | | | | | | | | | | | | | |
| 860' | m | M | m | MM | | | | | <m | | | | | | | | | | | | | | | |
| 1280' | | M | | M | m | | | | <m | | | | | | | | | | | | | | | |
| 1500' | m | M | | M | m | | | | <m? | <m | | | | | | | | | | | | | | |
| 1950' | <m? | | | <m? | MM | | M | | <m | | | | | m? | | | | | | | | | | CPX, AP |
| 2480' | | M | | M | | | <m? | | m | | | | | | | | | | | | | | | 2710' Qt vein |
| 2950' | M | | | MM | | | <m | | | | | | | | | | | | | | | | | |
| 3532' | m | | | <m? | MM | <m | <m | <m? | M | | | <m? | | m? | | | | | | | | | | CPX, AP |
| 3968' | M | | | m? | M | | m | | | | m | | <m | | | | | | | | | | | |
| 4500' | m | | | m? | M | | | | | <m | M | | <m | | <m | m | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| WELL 29-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| 467' | | | | | MM | | | | | | | | | M | | | | | | | | | | AP |
| 1297' | | M | m | MM | | | | | <m | | | | | | | | | | | | | | | |
| 1951' | | m | M | MM | | | | | <m | | | | | | | | | | | | | | | |
| 2375' | | | | | | | | <m | | | | | | MM | | | | | | | | | | AP |
| 2803' | <m? | | | <m? | MM | <m? | | <m? | M | | | | | m? | | | | | | | | | | AP |
| 3088' | | | | | MM | | | <m? | m | | | | | m? | | | | | | | | | | CPX, AP |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |

MM = PREDOMINANT M = MAJOR m = MINOR <m = <5 WT.% ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

27-27, 3000': ~ ± 2.71 Å PEAK (NOT PY. OR MARC.) MAY BE IMPURE HEMATITE
* MAY INCLUDE OTHER AMORPHOUS PHASES SUCH AS OPAL

| SAMPLE NO. | MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓ | | | | | | | | | | | | | | OTHER PHASES POSSIBLY PRESENT IN TRACE TO MINOR AM'TS. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QUARTZ | CRISTOBAL. | TRIDYMITE | K-FELDSP. | PLAGIOCL. | ILMENITE | HEMATITE | MAGNET. | SMECTITE | ILLITE &/OR MICA | CHLORITE | KAOLIN OR SERPENTINE | CALCITE | GLASS * | |
| WELL 14-23 | | | | | | | | | | | | | | | |
| 444' | <m | | | | MM | <m | | <m? | | | | | | m? | CPX, OPX, AP |
| 816' | | | | | M | <m | | | | | | | | M | AP, GOE |
| 1462' | | | | | MM | | | <m? | m | | | | | m? | AP |
| 1903' | | m | | | m | | | | | | | | | MM | |
| 2325' | <m | m? | m | M | m | | | | <m | | | | | | |
| 2599' | | | | | MM | | <m? | <m? | M | | | | | | AP |
| 2998' | | | | | MM | | | <m? | <m | | | | | m? | AP |
| | | | | | | | | | | | | | | | |
| WELL 18-34 | | | | | | | | | | | | | | | |
| 583' | | | | | MM | <m | | | | | | | | m? | AP, OLV |
| 1289' | | | | | | | | | | | | | | MM | |
| 1983' | m | M | m | M | | | <m | | <m | <m? | | | | | |
| 2507' | | M | | M | m | | | | | | | | | m? | |
| 2932' | | | | | MM | <m | <m | | m | | | | | m? | AP |
| 3498' | | | | | MM | <m | <m? | | m | | | | | m? | OPX, AP |
| | | | | | | | | | | | | | | | |
| WELL 27-27 | | | | | | | | | | | | | | | |
| 619' | | | | | MM | | | | | | | | | m? | CPX, AP |
| 1266' | | | | | MM | | <m? | | | | | | | m? | AP, OLV |
| 1635' | | | | | M | | | | | | | | | M | OLV |
| 2145' | | | | | MM | <m | <m? | | | | | | | m? | CPX, AP, OLV |
| 2543' | | | | | MM | <m | <m? | <m? | | | | | | m? | CPX, AP, OLV |
| 3000' | | | | | MM | | m? | | <m | | | | | m? | AP, OLV |

MM = PREDOMINANT  M = MAJOR  m = MINOR  <m = <5WT%  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

## Appendix 2

The distribution of alteration zones observed in temperature boreholes drilled in the Glass Mountain Area

| Well Name | Total Sampled Depth (T.D.) | Alteration Zones | Interval |
|---|---|---|---|
| GMF 56-3 | 1760' | Zeolite-Smectite | <205'-1058' |
| | | Argillic | 1058'-T D |
| GMF 45-36 | 4000' | Unaltered | 0 -1000' |
| | | Zeolite-Smectite | 1000'-1820' |
| | | Argillic | 1820'-2500' |
| | | | 3430 -3720' |
| | | Prophylitic | 2500 -3430 |
| | | | 3720'-T D |
| GMF 28-32 | 4500' | Unaltered | 0 -2480 |
| | | Zeolite-Smectite | 2480'-2680' |
| | | Argillic | 2680'-3460' |
| | | Propylitic | 3460 -T D |
| GMF 44-33 | 2263 | Unaltered | 0 -300' |
| | | Zeolite-Smectite | 300'-1350 |
| | | Argillic | 1350'-T D |
| GMF 17-6 | 4009' | Unaltered | 0 -1280' |
| | | Zeolite-Smectite | 1280 -2680' |
| | | Argillic | 2680 -T D |
| GMF 84-17 | 1636' | Unaltered | 0 -1419' |
| | | Zeolite-Smectite | 1419'-T D |
| GMF 87-13 | 916' | Unaltered | 0 -242 |
| | | Zeolite-Smectite | 242 -900' |
| | | Argillic | 900'-T D |
| ML 68-16 | 2939' | Unaltered | 0 -2227' |
| | | Zeolite-Smectite | 2227'-T D |
| ML 57-13 | 2929' | Unaltered | 0 -2928' |
| | | Zeolite-Smectite | 2929 -T D |
| ML 14-23 | 3003' | Unaltered | 0 -1462' |
| | | Zeolite-Smectite | 1462 -T D |
| ML 29-1 | 3088' | Unaltered | 0 -2803' |
| | | Zeolite-Smectite | 2803'-T D |

Appendix 2 (Cont )

| Well Name | Total Sampled Depth (T.D.) | Alteration Zones | Interval |
|---|---|---|---|
| ML 36-28 | 2246' | Unaltered | 0 -1500' |
| | | Zeolite-Smectite | 1500'-2084' |
| | | Argillic | 2084'-T D |
| ML 75-6 | 1998' | Unaltered | 0 -1050' |
| | | Zeolite-Smectite | 1050'-T D |
| ML 57-11 | 3002' | Unaltered | 0 -800 |
| | | Zeolite-Smectite | 800'-T D |
| ML 2-81 | 740 | Unaltered | 0 -T D |
| ML 86-23 | 3503' | Unaltered | 0 -1554' |
| | | Zeolite-Smectite | 1554 -3503 |
| ML 54-19 | 2201 | Unaltered | 0 -1900' |
| | | Zeolite-Smectite | 1900'-T D |
| ML 62-21 | 2142' | Unaltered | 0 -1035' |
| | | Zeolite-Smectite | 1035'-2115' |
| | | Argillic | 2115'-T D |
| ML 65-26 | 2180 | Unaltered | 0 -T D |
| ML 52-30 | 1972 | Unaltered | 0 -1100 |
| | | Zeolite-Smectite | 1100'-T D |
| ML 27-27 | 3000' | Unaltered | 0 -T D |
| ML 1-81 | 640' | Unaltered | 0 -640' |
| ML 18-34 | 3500' | Unaltered | 0 -2932' |
| | | Zeolite-Smectite | 2932'-T D |
| MLF 51-2 | 1836' | Unaltered | 0 -900' |
| | | | 1150'-T D |
| | | Zeolite-Smectite | 900 -1150' |

# APPENDIX C:
# Summary report on the geology and geochemistry of Glass Mountain Geothermal Reservoir, Glass Mountain KGRA, California

# Attachment II

# CEC-500-2007-XXX-ATII

# Summary report on the geology and geochemistry of Glass Mountain Geothermal Reservoir, Glass Mountain KGRA, California

This document is an attachment to a report funded by the California Energy Commission's Geothermal Resource Development Account (GRDA) Program. The GRDA Program did not fund this document, but the authors of the GRDA funded report have attached it as a supporting document.

The California Energy Commission wishes to thank the copyright holder, Calpine Corporation, for permission to republish this document in electronic format on the Energy Commission's website.

Please contact this document's author/publisher for additional information about the document.

Memorandum

GM 18 ...

UNOCAL 76

WA JISON CRECRAFT
JUN 26 1989 HRC for DS

June 23 1989

TO David Sussman

FM: Daniel L Carrier

RE: SUMMARY REPORT ON THE GEOLOGY AND GEOCHEMISTRY OF GLASS MOUNTAIN GEOTHERMAL RESERVOIR GLASS MOUNTAIN KGRA, CALIFORNIA

*This paper was initially proposed for presentation at the 1989 GRC meeting in Santa Rosa


Abstract:

Unocal has discovered a 479 to 556°F geothermal resource in the Glass Mountain KGRA in northeastern California Two commercial wells were successfully completed in the KGRA during 1988 that combined are capable of generating 7 5 MW of electricity to a single flash system

Production data indicate a reservoir thickness of at least 4000 feet Reservoir rocks are interlayered Quaternary and Tertiary lava flows and pyroclastics of dominantly basalt and basaltic andesite composition High-grade hydrothermal alteration is pervasive in these rocks Reservoir permeability is apparently controlled by a network of fractures with narrow apetures and by lava flow boundaries Porosities measured on core samples average four percent

Total dissolved solids in the reservoir fluids average less than 3200 ppm and non-condensible gases are less than 0 01% of the total mass flow The primary dissolved constituents in the brines are sodium-chloride and silica To date there has been no evidence for corrosion or scaling of production casing or surface equipment during flowtests


## INTRODUCTION

The Glass Mountain Known Geothermal Resource Area (KGRA) is situated in northeastern California on Medicine Lake volcano (Figure 1) The KGRA is named for Glass Mountain a 1000 year old rhyolite obsidian dome which is located on the eastern

topographic rim of the volcano This and several other young silicic domes and a small area of weak fumarolic activity known as the Hot Spot attracted geothermal interest in the volcano

UNOCAL Geothermal began a program of exploration in 1981 to evaluate the geothermal potential of the Glass Mountain KGRA Extensive geologic geothermic and geophysical surveys identified a geothermal anomaly suitable for deep exploratory drilling in an area located southwest of Glass Mountain A discovery well and confirmation well were successfully completed and tested in the anomaly during 1988 (Figure 1) This paper presents a summary of the data collected from these exploratory wells

## GEOLOGIC SETTING

Medicine Lake volcano is a Quaternary shield volcano located in the southern part of the Cascade Range about 35 miles east-northeast of Mount Shasta Lavas attributed to the volcano are found over a 780 $mi^2$ area and have an estimated volume of 145 $mi^3$ (Donnelly-Nolan 1988) Although Holocene volcanics are principally bimodal basalts and rhyolites the dominant lavas on the upper slopes of the volcano are andesitic Several small volcanic centers of basalt andesite dacite and rhyolite coalesce to form a constructional rim on the summit of Medicine Lake volcano enclosing a 4 x 6 mile depression The topographic depression has been called a caldera by several authors (Anderson 1941; Heiken 1978; Donnelly-Nolan 1988) however there is no evidence for significant subsidence In addition no faults or massive tuffs associated with caldera collapse have been identified either on the surface or in drill holes Five Holocene silicic eruptive centers are located in a 4 5 x 12 mile band across the upper flanks topographic rim and the summit depression of Medicine Lake volcano (Figure 1) Glass Mountain is the youngest of these silicic centers

Only one active hydrothermal manifestation is known in the Glass Mountain KGRA Surficial activity is restricted to a zone of weak fumaroles located one mile west-northwest of Glass Mountain at the Hot Spot (Figure 1) A temperature of 168°F was recorded for the largest fumarole at the Hot Spot in July 1983 by extending a maximum-reading thermometer 12 feet down into the vent Surface exposures of hydrothermal alteration are also rare in the KGRA Presumably this is due to the widespread pumice tephra which blanketed the area during the eruptions of the Holocene silicic lavas Significant hydrothermal alteration has been found in the summit depression of Medicine Lake volcano at locations near Schonchin Spring and Crystal Springs (see Figure 1) Argillic alteration and local silicification are observed at both of these locations

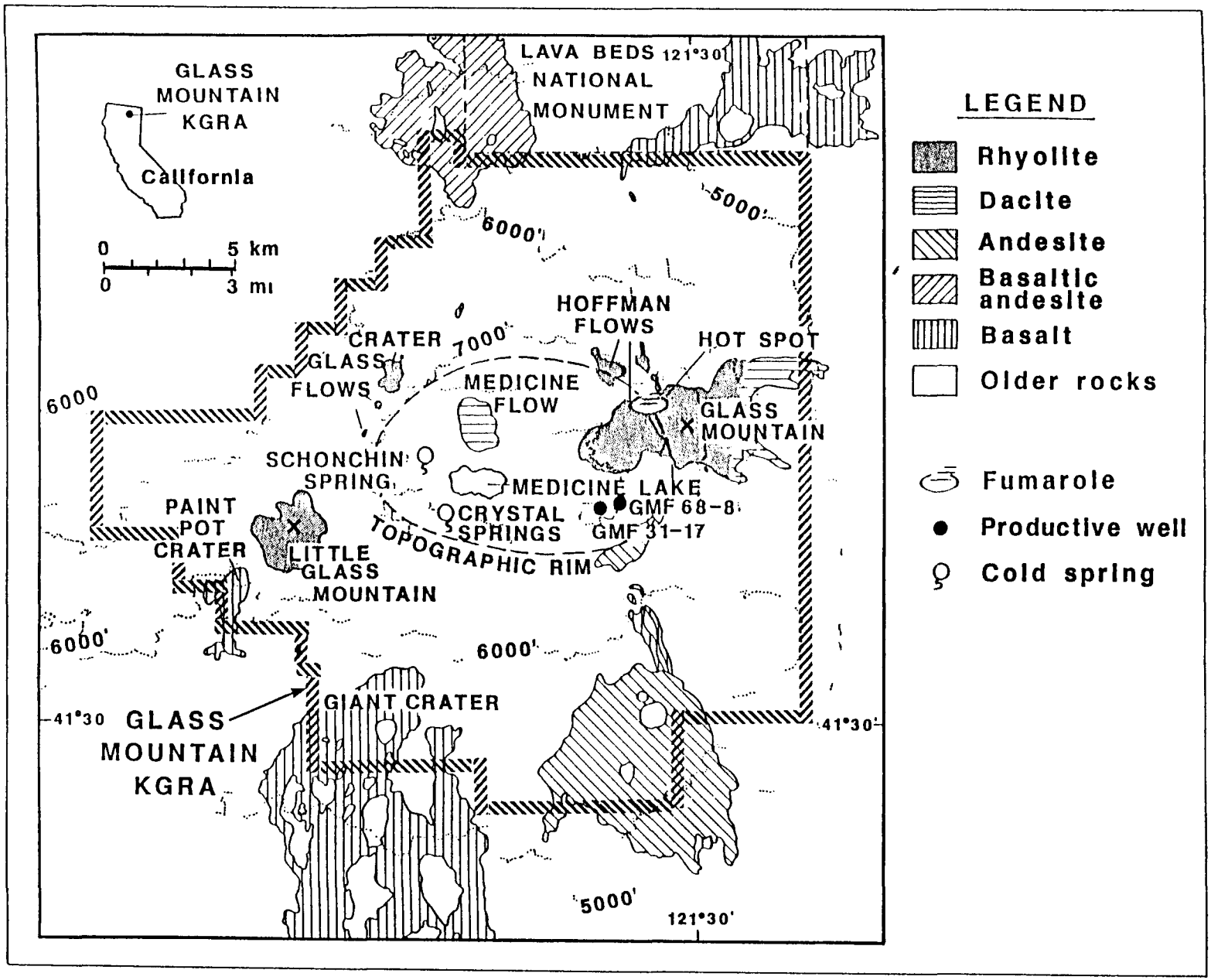



Figure 1 Geologic Map of Medicine Lake Volcano showing Holocene lavas (Donnelly-Nolan, 1988) and the Glass Mountain KGRA.



DLC/jmf/5268T
Ctlg No HGA07 0101

## DRILLING

UNOCAL drilled the Glass Mountain geothermal resource discovery well GMF68-8 on a location about 2 4 miles southwest of Glass Mountain (Figure 1) The well was spudded on July 17 1985 and rotary drilled to a total depth of 6571 feet The well was initially completed on August 19 1985 and shut-in without being tested Temperatures and pressures were monitored in the well until July 1988 when the site was re-occupied The well was then deepened to 8417 feet and a seven inch perforated liner run into the hole from 3377 to 8410 feet GMF68-8 was completed as a geothermal producer on July 31 1988

The confirmation well for the Glass Mountain geothermal resource GMF31-17 is located one-half mile west-southwest of GMF68-8 GMF31-17 was spudded on August 4 1988 and drilled to a total depth of 8787 feet A seven inch perforated liner was run in the hole from 2890 to 8777 feet The well was completed as a geothermal producer on September 13 1988

## LITHOLOGY

Rock lithologies and thicknesses have been determined for both wells by integrating data obtained from drill cuttings and core samples and interpretation of gamma ray logs Generalized lithologic logs are presented for GMF68-8 in Figure 2 and for GMF31-17 in Figure 3 The drill cuttings and core samples have been examined petrographically and analyzed by X-ray diffraction and whole-rock analyses Chip samples were collected in 10 or 20-foot intervals The core samples were collected between 6580 and 6603 feet and 8399 to 8417 feet in GMF68-8 and between 8416 and 8436 feet in GMF31-17

The Glass Mountain wells drilled a sequence of interlayered volcanic rocks consisting of lavas thinly bedded lithic tuffs mafic cinders and volcanic detritus of Quaternary and Tertiary age Whole-rock analyses show the bulk of the lavas have a calc-alkalic to slightly alkalic affinity Mafic lavas predominate and range from aphyic to porphyritic amygdaloidal basalt and basaltic andesite Fine-grained silicic lavas with granophyric and spherulitic textures occur at numerous depths in the wells Andesite lavas which are the most common surface rocks on the upper slopes of Medicine Lake volcano are relatively rare in the subsurface GMF31-17 drilled a sequence of meta volcanics hornfels and dikes of fine grained hornblende granodiorite between 8060 and 8787 feet The thickest granodiorite dike had a measured thickness of 280 feet

## HYDROTHERMAL ALTERATION

Hydrothermal minerals occur as vein and vug fillings and as alteration products of primary minerals The distribution of hydrothermal minerals with depth is shown in Figure 2 for

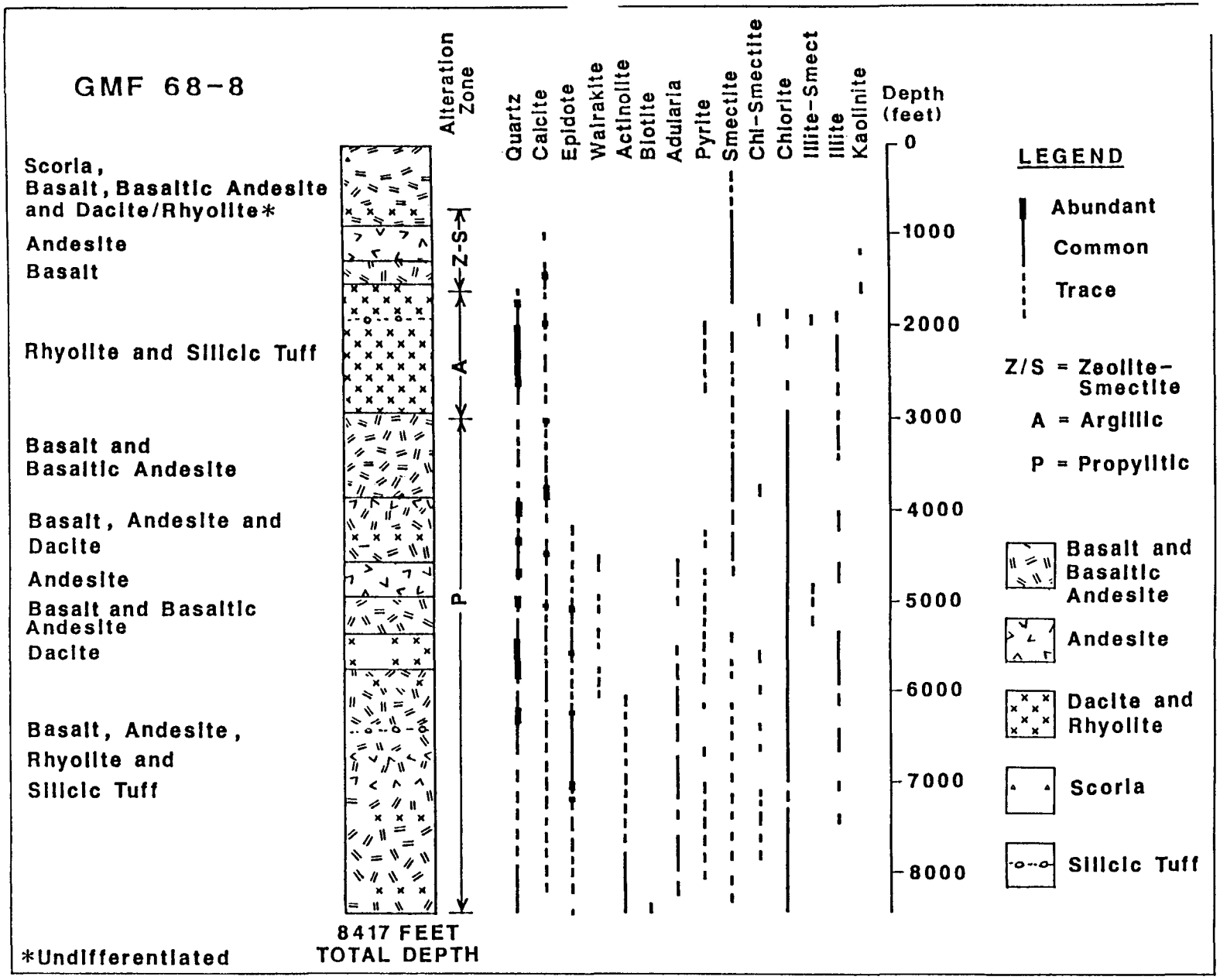



Figure 2 Lithology and mineralogy profile of GMF68-8



DLC/jmf/5268T
Ctlg No UCA07 0101

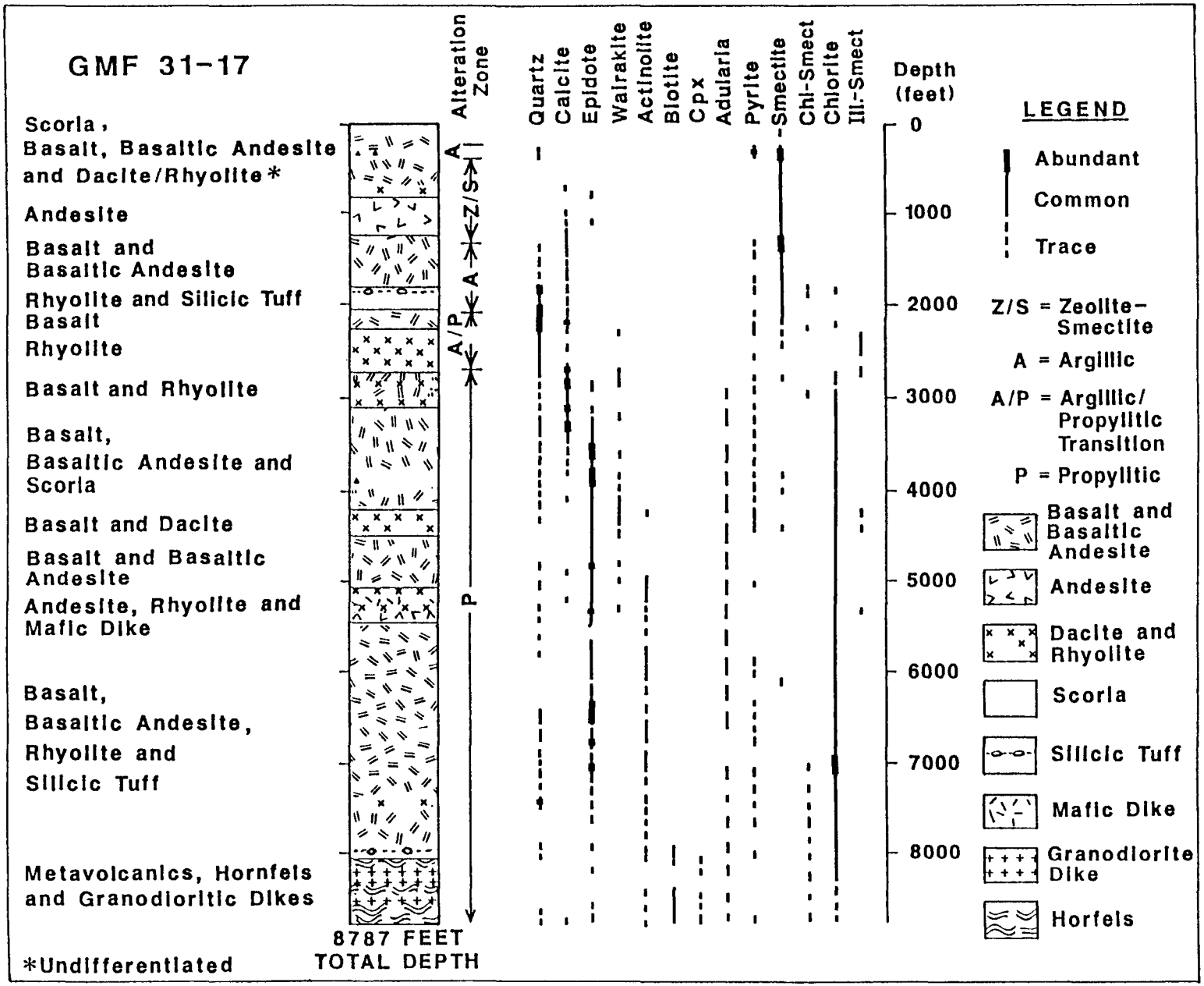



Figure 3 Lithology and mineralogy profile of GMF31-17



DLC/jmf/5268T
Ctlg No UCA07 0101

GMF68-8 and Figure 3 for GMF31-17 Diagnostic assemblages of hydrothermal minerals are classified into three distinctive types or zones: zeolite-smectite argillic and propylitic This classification is a modification of those presented by Rose and Burt (1979) Kristmannsdottir (1982) and Guilbert and Park (1985) and is based on observed mineralogy The zeolite-smectite zone is defined here by the presence of either low-temperature zeolites or of hydrothermal smectite clay in concentrations greater than three percent of the whole-rock The argillic alteration zone is defined by the presence of hydrothermal quartz and either hydrothermal smectite or kaolinite The propylitic alteration zone begins when any two of the following four secondary minerals are present: albite epidote calcite (replacing plagioclase) and chlorite (greater than smectite)

GMF68-8 is essentially unaltered down to the top of the zeolite-smectite zone at 700 feet (Figure 2) Alteration intensity then increases steadily with depth Argillic alteration begins at 1640 feet in the well and is followed by propylitic alteration at 3000 feet Propylitic alteration is weak in the 3000 to 4120-foot interval and moderate to strong at greater depths Strong propylitic alteration is often associated with the brecciated zones at the tops and bottoms of lava flows suggesting that these have been a preferred pathway for hydrothermal fluids Wairakite is first observed at 4660 feet and last seen at 6400 feet Actinolite is first observed in veins and replacing primary pyroxene and hornblende at 6400 feet and displaces epidote as the principal calcium silicate mineral below 6900 feet Hydrothermal biotite occurs at 8409 feet

The pattern of hydrothermal alteration in GMF31-17 is less systematic than GMF68-8 Shallow weak argillic alteration is observed at 260 to 380 feet This argillic alteration overlies a zone of lower temperature zeolite-smectite alteration which extends to 1320 feet Anomalous traces of hydrothermal epidote were identified at 800 feet and 1100 feet in the low-temperature zeolite-smectite assemblage as shown in Figure 3 A deeper zone of argillic alteration begins at 1320 feet and extends at least to 2100 feet A transition between argillic alteration and propylitic alteration occurs in the 2100 to 2740-foot interval This transition zone is characterized by the occurrence of mixed-layered chlorite-smectite and illite-smectite clays and the spotty occurrence of poorly crystallized epidote and chlorite Well-developed propylitic alteration begins at 2740 feet and continues to the total depth of the well Wairakite is observed in the 2800 to 5300-foot interval Hydrothermal actinolite is first observed at 4220 feet hydrothermal biotite at 7900 feet and hydrothermal clinopyroxene at 8030 feet Hydrothermal alteration below 8060 feet is superimposed on an older contact metamorphic zone possibly associated with the

intrusion of the granodioritic dikes Much of the biotite and clinopyroxene observed below 8060 feet appears to be metamorphic although hydrothermal veins containing biotite and clinopyroxene are also found

## PHYSICAL CHARACTERISTICS OF THE RESERVOIR

The geothermal system at Glass Mountain is an under-pressured liquid-dominated resource Static water levels in GMF68-8 and GMF31-17 are at 1100 feet and pressures below 1100 feet follow hydrostatic gradients

The maximum temperature observed in GMF68-8 is 556°F at 7900 feet (Figure 4) Temperatures in this well increase rapidly from 121°F to 416°F in the 1000 to 2000-foot interval and follow the boiling-point depth curve from 2000 to 3500 feet Temperatures at depths greater than 3500 feet are less than boiling and a six degree reversal is observed in the 4800 to 5600-foot interval A small isothermal section is observed at the bottom of the hole in the 7900 to 8200-foot interval that is possibly a relic of a 32-hour production test (Figure 4)

The maximum temperature shown for GMF31-17 in Figure 4 is 525°F at 8300' The temperatures in the 2000 to 3000-foot interval of GMF31-17 are essentially identical to those in GMF68-8 and follow the boiling-point depth curve Temperatures in GMF31-17 however appear isothermal in the 3000 to 3400-foot interval and then reverse 15°F to 479°F at 3900 feet Measured temperatures increase gradually between 3900 and 7000 feet with an average gradient of less than 0 5°F/100 feet The thermal gradient begins to increase at 7000 feet and reaches 4 7°F/100 feet in the 8000 to 8300-foot interval of the well

The integration of temperature pressure and spinner surveys (TPS) has led to the identification of several zones of reservoir permeability Permeable zones have been found as shallow as 3800 feet in GMF31-17 and as deep as 8250 feet in GMF68-8 The TPS data in addition to the mineralogical data suggest a potential reservoir thickness of 4000 to 5000 feet in the vicinity of the two wells

Laboratory measurements indicate the average core porosity from both wells is four percent The highest measured porosities for a core of 3 6 to 6 8% are observed in mafic lavas from 6580 to 6604 feet in GMF68-8 Well-developed subvertical fractures and open spaces are also observed in the GMF68-8 core The intensity of alteration in this core sample increases with proximity to the subvertical fractures

Rock samples produced during an openhole flowtest conducted prior to the completion of GMF68-8 probably provide the best glimpse of the producing zones within reservoir The well surged and unloaded softball-sized rocks up to six inches in diameter of propylitically altered dacite and sand-sized grains

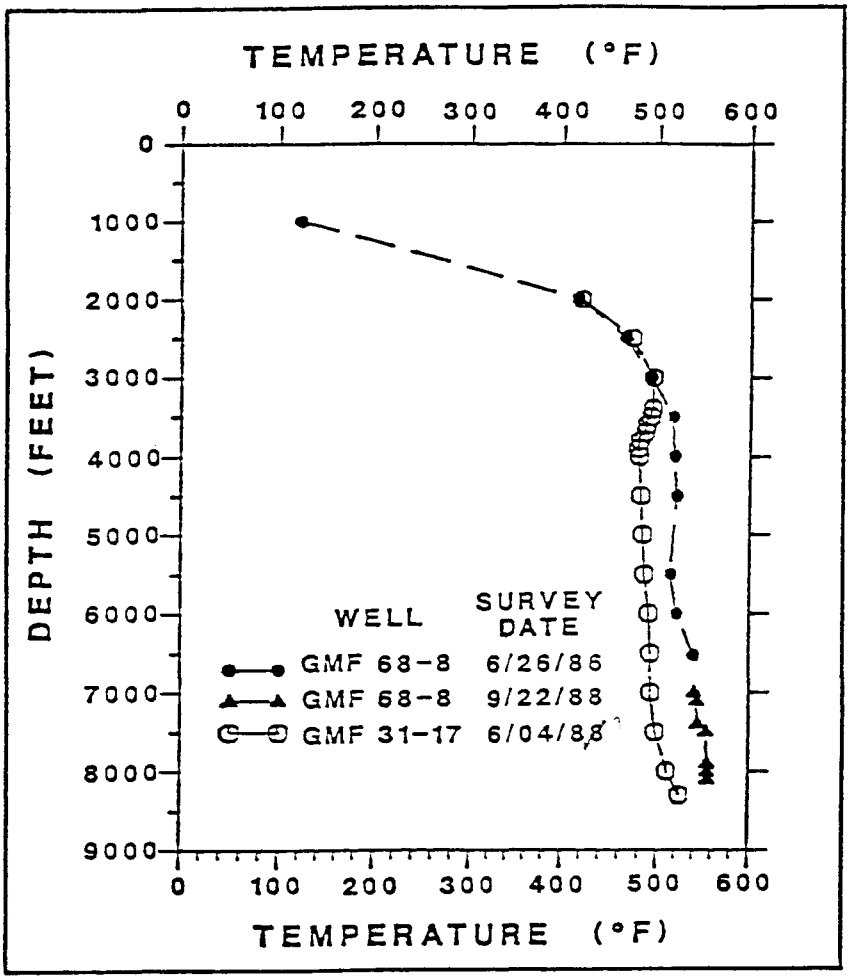



Figure 4: Temperature-depth profiles for GMF68-8 and GMF31-17 The 6/26/86 survey of GMF68-8 was taken before the well was deepened and after the well was static for 311 days The 9/22/88 survey of GMF68-8 was taken after the well was deepened and four days after a 32-hour flowtest The 6/04/88 survey of GMF31-17 was taken after the well had been static for 247 days

of epidote and quartz The chemistry and mineralogy of these lavas are similar to dacites observed in the 5400 to 5800-foot interval of the well This is also an interval identified in TPS surveys to be a zone of enhanced permeability These samples are cut by fractures many of which are open as wide as 0 125 inches Porosities measured on plugs cut from these samples range from 9 3 to 14 1 percent

## PRODUCTION AND GEOCHEMICAL DATA

Both Glass Mountain wells were flowtested after completion in the fall of 1988 Production rates for the wells were determined by measuring the pressure drop of the two-phase fluid across an orifice plate using the Murdock (1961) equation This method requires a known enthalpy for the fluid The values of enthalpy used in these calculations were based on near-static downhole temperatures measured prior to the test This method usually gives results that are within ten percent of results obtained from using a separator

The Glass Mountain wells together are capable of producing sufficient steam at 102 psia wellhead pressure to generate at least 7 5 megawatts of electricity using a single flash system GMF68-8 produces 72 000 lb/hr of steam from a 300 000 lb/hr total mass flow and GMF31-17 produces 78 000 lb/hr of steam from a 480 000 lb/hr total mass flow These numbers are derived from deliverability curves developed by testing the wells at several rates Temperatures in the primary producing zone of GMF31-17 have increased 20°F in the first seven months following the completion of the 1988 flowtests Greater steam production is therefore expected for GMF31-17

The reservoir fluids are low-salinity low gas waters (Table 1) Total dissolved solids in the fluids produced from both wells are less than 3200 ppm The primary dissolved constituents are sodium-chloride and silica and non-condensible gases in the fluids are less than 0 01 weight percent of the total mass flow The concentration of $H_2S$ in the total mass flow is less than 3 ppm No evidence for corrosion or scaling of production casing or surface equipment has been found after more than 285 hours of continuous testing of GMF31-17 and 85 hours of nearly continuous testing of GMF68-8

DLC/jmf/5268T

Table 1: Geochemistry of reservoir fluids from Glass Mountain wells GMF68-8 and GMF31-17 *

| Well Name: | GMF68-8 | GMF68-8 | GMF31-17 | GMF31-17 | GMF31-17 |
|---|---|---|---|---|---|
| Hours into flowtest: | 28 | 52 | 129 5 | 250 | 285 5 |
| Water (1) | | | | | |
| pH | 8 4 | 8 3 | 5 3 | 7 1 | 7 2 |
| TDS(2) | 2962 | 2713 | 3183 | 3121 | 3028 |
| $SiO_2$ | 476 | 477 | 547 | 509 | 500 |
| Na | 841 | 754 | 906 | 894 | 874 |
| K | 143 | 132 | 142 | 143 | 140 |
| Ca | 12 2 | 8 9 | 25 9 | 19 3 | 18 5 |
| Mg | 0 1 | 0 1 | 0 7 | 0 1 | 0 1 |
| Li | 6 2 | 6 2 | 5 5 | 5 5 | 5 4 |
| Cl | 1412 | 1266 | 1483 | 1468 | 1409 |
| $HCO_3$ | 26 | 27 | 4 | 14 | 16 |
| $SO_4$ | 28 | 27 | 46 | 46 | 44 |
| Gas (3) | | | | | |
| $CO_2$ | 90 7 | 90 7 | 56 0 | -- | -- |
| $H_2S$ | 7 7 | 2 1 | 4 2 | -- | -- |
| $CH_4$ | <0 3 | 0 1 | <0 3 | -- | -- |
| $H_2$ | 0 2 | 1 2 | 2 9 | -- | -- |
| $N_2$ | 3 2 | 6 2 | 34 7 | -- | -- |
| Air (4) | 1 7 | 0 2 | 2 0 | -- | -- |
| Total %Gas(5) | 004 | 008 | 006 | -- | -- |
| $H_2S$ (6) | 2 4 | 1 3 | 2 4 | -- | -- |

*Flowtest of GMF31-17 was preceded by an acid job Traces of acid contamination are still present in these brine samples

(1) Reported as mg/kg of total flow Samples collected at atmospheric pressures and corrected to total flow based on reservoir temperature and single phase brine

(2) Calculated

(3) Volume percent of dry air-corrected gas

(4) Based on oxygen in uncorrected analysis and atmospheric gas ratios

(5) Calculated as weight-percent of total flow

(6) In mg/kg of total flow

DLC/jmf/5268T

## REFERENCES


Anderson C A 1941 Volcanoes of the Medicine Lake Highland California Univ Calif Publ Bull Dep Geol Sci 25 p 347-422

Cox K G Bell J D and Pan Kurst R J 1979 The Interpretation of Igneous Rocks Allen and Unwin London

Donnelly-Nolan J M 1988 A magmatic model of Medicine Lake Volcano California Jour geophys Res v 93 p 4412-4420

Guilbert J M and Park C F Jr 1986 in The Geology of Ore Deposits W H Freeman and Company New York p 180-197

Heiken G 1978, Plinian-type eruptions in the Medicine Lake Highland California and the nature of the underlying magma J Volcanol Geotherm Res v 4 p 375-402

Kristmannsdottir H 1982, Alteration in the IRDP drill hole compared with other drill holes in Iceland Jour Geophys Res v 87 p 6525-6531

Murdock J W 1961 Two-phase flow measurement with orifice ASME Paper 61-WA-27 14 pp

Rose A W and Burt D M 1979 Hydrothermal Alteration in Geochemistry of Hydrothermal Ore Deposits H L Barnes ed John Wiley & Sons New York p 173-235

# APPENDIX D:
# Hydrothermal alteration and well lithologies for Glass Mountain wells GMF68-8, GMF31-17 and GMF17A-6, Glass Mountain, CA

GM 19.01

**Unocal Geothermal Division**
Unocal Corporation
3576 Unocal Place, P.O. Box 6854
Santa Rosa, California 95406
Telephone (707) 545-7600

DAVID SUSSMAN

OCT 24 1989

**UNOCAL 76**

August 8, 1989

TO: David Sussman

FM: Daniel L. Carrier DLC by D.S.

RE: HYDROTHERMAL ALTERATION AND WELL LITHOLOGIES FOR GLASS MOUNTAIN WELLS: GMF68-8, GMF31-17 AND GMF 17A-6

SUMMARY

Petrologic, geochemical and temperature data from three exploratory wells indicate a well-developed geothermal system exists in the Glass Mountain area of the Medicine Lake volcano. Wells GMF68-8, GMF31-17 and GMF17A-6 penetrate a sequence of interlayered volcanic, contact metamorphic, and granodioritic intrusive rocks. The interlayered volcanics are the principal reservoir rocks for the Glass Mountain system. Alteration zoning is well-developed in all the wells and generally follows a sequence from zeolite-smectite to argillic and finally to propylitic with increasing depth. Strong argillic alteration and boiling temperatures observed in GMF68-8 and GMF31-17 suggest the upwelling of geothermal fluids, and correlate well with low-resistivity anomalies observed in time-domain electromagnetic and magnetotelluric data. The occurrence of only weak to moderate argillic alteration in GMF17A-6 is consistent with temperature data which indicate the well was not drilled in an area of upwelling and boiling. Strong propylitic alteration occurs in each well, and is primarily found along subvertical fractures and the brecciated tops and bottoms of lava flows. The association of fractures and lithologic boundaries with strong propylitic alteration suggests that these features are the preferred pathways for fluid flow.

Mineralogical data suggest that multiple hydrothermal systems have existed in the Glass Mountain area. Caution is therefore needed in using the first occurrence of epidote to identify the top of the reservoir. In addition to epidote, other significant hydrothermal minerals present include actinolite, wairakite, and clinopyroxene. Smectite and chlorite are the most common hydrothermal clays observed. Smectite occurs in trace amounts at 556°F in GMF68-8, roughly 150°F in excess of its equilibrium temperature stability range, suggesting that low matrix permeability exists in portions of the reservoir.

The drilled stratigraphy of the volcanic complex near Glass Mountain suggests a thickness of 4600 feet for the Medicine Lake lavas in the wells, but no subsidence due to catastrophic ash eruption. The base of Medicine Lake volcano is interpreted at an elevation of 2500 feet, roughly 1500 feet lower than the flank exposures of Medicine Lake lavas. Pre-Medicine Lake lavas are intruded by granodiorites, which are interpreted to be the intrusive phases of silicic rocks associated with the volcano. Variations in the thickness of the volcanic complex are probably due to paleotopography, or the gradual subsidence of the volcano by repeated magma withdrawal or isostatic compensation of the growing volcanic mass.

## RECOMMENDATIONS

The following recommendations are made:

1. Pursue detailed mineralogical studies on future wells drilled at Glass Mountain, and integrate these studies with existing mineralogical and geophysical data to produce a three-dimensional development model for the Glass Mountain system.

2. Integrate fluid inclusion data to establish the relationships between mineral temperatures and current reservoir temperatures and fluids.

3. Collect and integrate additional petrological and mineralogical data from existing and future wells to correlate volcanic units and develop a three-dimensional model of the Medicine Lake volcano complex; both products will be useful in developing the geothermal system.

DLC/jmf/5285T
Ctlg. No.:UCA07.2701

TABLE OF CONTENTS


| | Page |
|---|---|
| Summary | 1 |
| Recommendations | 2 |
| Table of Contents | 3 |
| Introduction | 3 |
| Geological Setting | 3 |
| Methods and Data | 5 |
| Lithology | 6 |
| Alteration Mineralogy | 8 |
| Calcium Silicates | 12 |
| Phyllosilicates | 18 |
| Alteration Zones | 20 |
| Conclusions | 23 |
| References | 26 |
| Appendix 1.- XRD ANALYSES | 28 |
| Appendix 2.- MAJOR OXIDE ANALYSES | 29 |


## INTRODUCTION

The Glass Mountain Federal Unit is formed from Unocal and Freeport-McMoran geothermal leases located at the summit of Medicine Lake volcano. Three deep exploratory wells have been completed in the Glass Mountain Federal Unit since 1984: GMF68-8, GMF31-17 and GMF17A-6 (Figure 1). This report discusses the general lithology and hydrothermal mineralogy of these wells. The objective is to describe the relationships existing at depth among rock-type, alteration, subsurface temperature, and permeability.

Mineralogy of the deep wells will be presented in two reports. This report discusses hydrothermal alteration and lithologic data. A subsequent report will discuss fluid inclusion data obtained on hydrothermal minerals. The ultimate goal of these studies is to develop a three-dimensional model of the Glass Mountain geothermal system. These reports follow an earlier study by Carrier (1987) which dealt with hydrothermal alteration and fluid inclusion data from Glass Mountain temperature boreholes.

## GEOLOGIC SETTING

Medicine Lake is a Quaternary shield volcano situated in the southern part of the Cascade Range about 35 miles (56 km) east-northeast of Mount Shasta. Lavas attributed to the volcano are found over a 780 $mi^2$ (2000 $km^2$) area, and have an estimated volume of 145 $mi^3$ (600 $km^3$) (Donnelly-Nolan, 1988). Although Holocene volcanic rocks are principally bimodal basalt and rhyolite, the upper slopes of the volcano are dominated by andesite lavas of Pleistocene age. Silicic lavas account for 5 to 10% of the surface lavas on the volcano (Figure 1). The silicic lavas occur in four age groups based

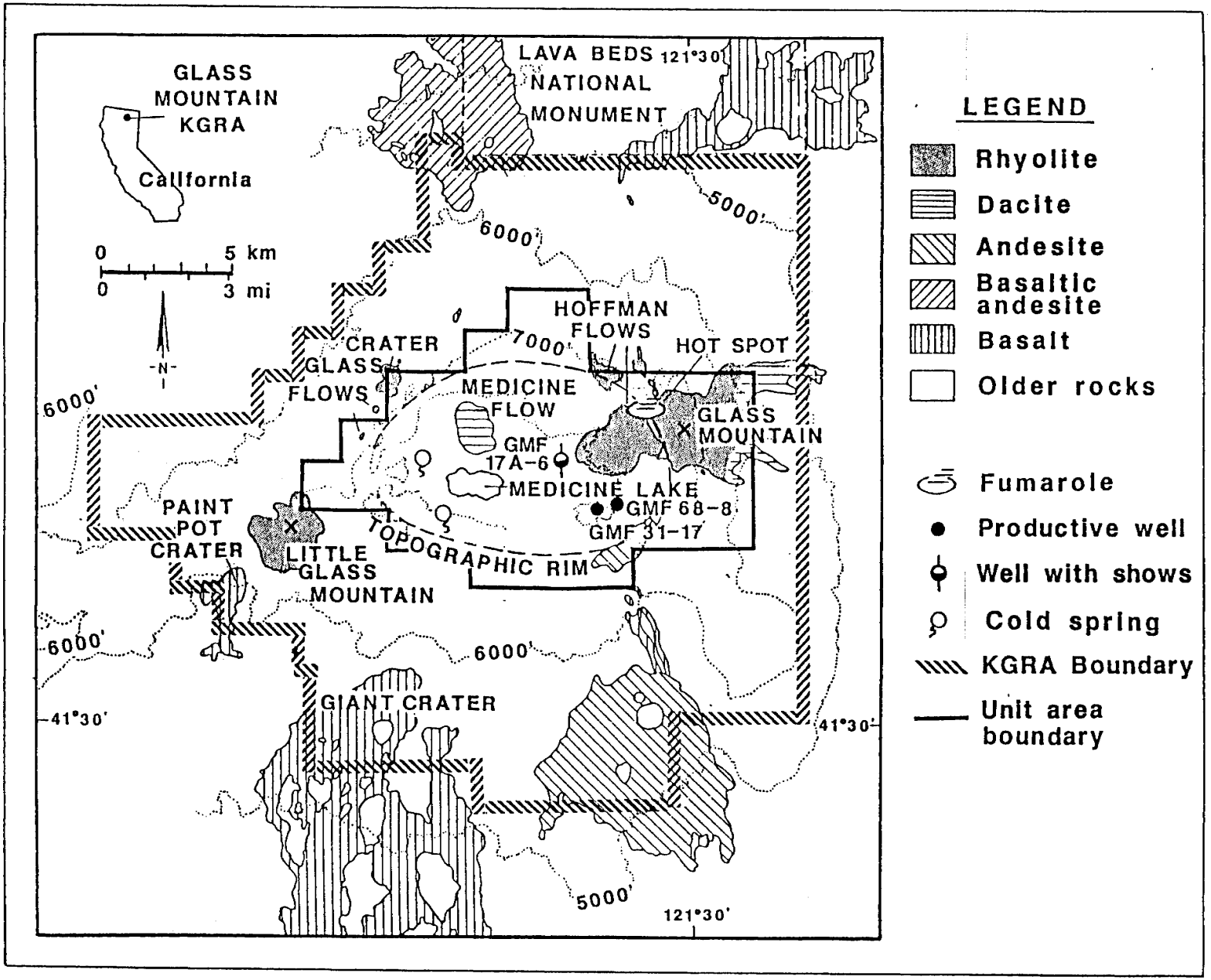



Figure 1: Geologic map of Medicine Lake volcano showing lavas that are less than 11,000 years old (Donnelly - Nolan, 1988) and the Glass Mountain KGRA.

DLC 7/89
UCA07.2701

on K-Ar age dates: 1.25 to 0.95 m.y., 0.61 to 0.43 m.y., 0.33 to 0.24 m.y., and 0.1 m.y. to about 1,000 years (Mertzman, 1982; Mertzman, 1983).

Several small volcanic centers of basalt, andesite, dacite and rhyolite coalesce to form a constructional rim on the summit of Medicine Lake volcano, enclosing a 4 x 6 mile oval depression. The topographic depression has been called a caldera by several authors (Anderson, 1941; Heiken, 1978; Donnelly-Nolan, 1988). However, there is no evidence on the surface for ring faults or massive tuffs, and no evidence for massive tuffs in the subsurface (Carrier, 1987).

Five silicic eruptive centers, all less than 2,000 years in age (Donnelly-Nolan, personal communication), are located in a 4.5 x 12 mile band across the upper flanks, topographic rim and the summit depression of Medicine Lake volcano (Figure 1). Glass Mountain is the youngest of these silicic centers. The three deep wells were drilled in the topographic depression, and each is located less than 3 miles from the Glass Mountain dome.

No basement rocks are exposed in the Glass Mountain area. Granodioritic xenoliths have been found in the young silicic lavas shown in Figure 1. Hausback (1984) suggested the xenoliths were fragments of a Sierran plutonic basement; however textures in the granodiorites indicate they are subvolcanic equivalents of Glass Mountain lavas. The oldest rocks exposed in the vicinity of the volcano are Tertiary basalt and andesitic pyroclastic rocks belonging to the Cedarville Series (Anderson, 1941). These are exposed in several small fault-block mountains north and east of the volcano. Overlying the Cedarville Series are high-alumina olivine basalts of Miocene to Pleistocene age that have been collectively lumped together into a group called the Warner Basalts. Xenoliths of high-alumina basalts have also been observed in the young silicic lavas on the Medicine Lake volcano.

## METHODS AND DATA

Data presented in this report have been collected through several methods of study. Drill cutting samples were collected at 10 or 20-foot intervals, and spot cores were taken from depths of 6580 to 6603 feet and 8399 to 8417 feet in GMF68-8 and 8416 to 8436 feet in GMF31-17. The samples were logged using a binocular microscope. Representative samples were then selected for further analysis by thin section, x-ray diffraction (XRD) and whole-rock chemistry. The XRD analyses were done at the University of Utah Research Institute by Jeff Hulen and Susan Lutz. The basic data are reported in Appendix 1. Whole-rock chemical analyses data were done by Chemex Labs, in Sparks, Nevada. The data are presented in Appendix 2. In addition to the sample analyses, each well has been at least

partially logged with a gamma ray tool. Dresser Atlas, Schlumberger and Welex logging companies have run logs over different intervals of the wells.

All well depths mentioned in this report are measured depths unless stated otherwise. Elevations, as determined by using true vertical depths, are displayed in the cross-sections. The surface elevation of GMF68-8 is 6991 feet, GMF31-17 is 7000 feet, and GMF17A-6 is 6733 feet. GMF68-8 is drilled as a vertical hole to 6603 feet, and as a directional hole to the measured total depth of 8417 feet and true vertical depth of 8394 feet. GMF31-17 is drilled as a vertical hole to about 2010 feet, and as a directional hole deviated to the measured total depth of 8787 feet and true vertical depth of 8518 feet. GMF17A-6 is drilled as a vertical hole to a measured total depth of 9620 feet and a true vertical depth of 9605 feet.

## LITHOLOGY

Rock types and thicknesses have been determined for each well by integrating data obtained from drill cuttings, spot core samples, interpretation of gamma ray logs, and whole-rock chemical analyses. Generalized lithologic logs are presented for the wells in Figure 2. Rocks penetrated by the wells are assigned to one of three groups: interlayered volcanics, contact metamorphics, and granodioritic intrusives. The metamorphic rocks and the granodioritic intrusive rocks are found only in GMF31-17 and GMF17A-6.

The majority of the rocks drilled are interlayered volcanics. The volcanic group generally consists of calc-alkalic to slightly alkalic mafic, intermediate, and silicic lavas. Thinly bedded lithic tuffs, scorias, volcaniclastics, and sandstones occur in minor amounts. Mafic lavas are present in the greatest abundance and are dominated by clinopyroxene-bearing amygdaloidal basalts and basaltic andesites. Although the mafic rocks in general vary from aphyric to porphyritic, they become coarser grained at about 4600 feet measured depth (2500 feet in elevation), and contain microdiabase textures in trace to major amounts. These coarser grained mafic rocks possibly mark the base of the lavas related to the Medicine Lake volcano. That places the base of the volcano in the Glass Mountain area at an elevation which is 1500 feet lower than is evident by the flank exposures of Medicine Lake lavas. Rhyolite to dacite silicic lavas are second to the mafic lavas in abundance. Silicic lavas are more abundant in the wells than on the surface, accounting for 27% of the rocks drilled in the upper 4600 feet of the wells, and 20% of the volcanic rocks drilled below that depth. These rocks are typically microcrystalline to fine-crystalline, and are almost entirely composed of quartz, plagioclase, and potassium feldspar. Granophyric and spherulitic textures are common and well-developed. Micropegmatitic and axiolitic textures are also found in many of the silicic rocks. Dacitic rocks at 1750 to

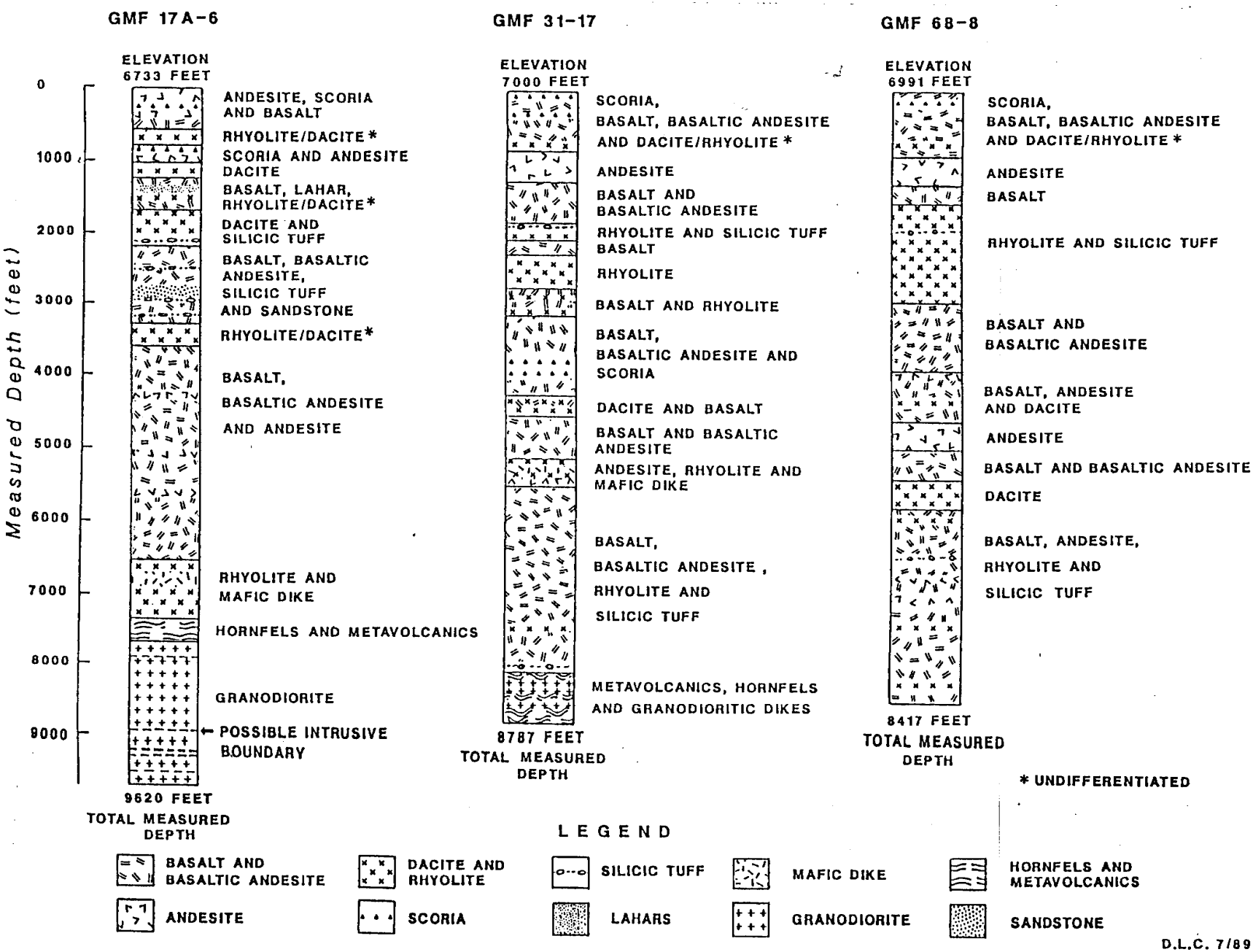



Figure 2: Generalized lithologic profiles of GMF17A-6, GMF31-17, and GMF68-8.

2160 feet in GMF17A-6 contain fine-crystalline granodioritic xenoliths. Although andesite and trachyandesite lavas are the most common lavas exposed on the volcano (Hausback, 1984), they are the rarest of the lavas observed in the deep wells. The andesites drilled are orthopyroxene or clinopyroxene bearing, are commonly flow banded, and contain aphyric to porphyritic textures.

Contact metamorphic rocks are found at 7345 to 7690 feet in GMF17A-6, and at 8060 to 8787 feet in GMF31-17. The metamorphic rocks are in general meta-volcanics and hornfels. The hornfels, as sampled in GMF17A-6, is essentially fine-crystalline quartz-plagioclase-biotite rock containing minor hornblende and clinopyroxene. Near the base of the GMF17A-6 sequence at 7680 feet, the metamorphic rocks are moderate-to well-foliated, and appear to be intermediate between a hornfels and a phyllite or a fine-crystalline schist. Contact metamorphic rocks in GMF31-17 consist of meta-andesites, meta-dacites, and hornfels, all of which are intercalated with granodioritic dikes or sills. The meta-andesite and meta-dacite rocks have poorly defined textures, and the hornfels rocks contain well-developed granoblastic textures.

Granodiorites occur as shallow plutonic rocks at 7690 to 9620 feet in GMF17A-6 and as multiple thin dikes or sills at 8110 to 8787 feet in GMF31-17. The granodioritic rocks are fine-crystalline and contain biotite and hornblende. Exsolution textures are common in the potassium-rich portions of the granodiorites. The granodiorites are similar in composition and texture to the xenoliths of plutonic rocks contained in surface exposures of the young silicic rocks. Abrupt variations are observed in the percentages of potassium feldspar and mafic minerals in the granodiorite in GMF17A-6, and are possibly due to the drilling of multiple intrusive bodies. The more mafic zones have compositions that approach quartz diorite. The rapid change from volcanics to meta-volcanics to fine-crystalline granodiorite without intervening erosional events indicates that the granitic rocks have been intruded into the older Tertiary volcanics. Thus the granodiorite rocks probably represent intrusive phases related to late Tertiary or Quaternary silicic lavas and not Sierran plutonic rocks. The thickest granodioritic dike in GMF31-17 has an apparent measured thickness of 280 feet.

## ALTERATION MINERALOGY

Alteration minerals present in the well samples are generally the same as those observed in other well-documented geothermal areas. The types and distribution of the minerals are shown as a function of depth in Figures 3, 4, and 5. Temperature, rock type, and permeability are the three main factors controlling the style and intensity of alteration in the Glass Mountain wells. A diagram summarizing the distribution of selected

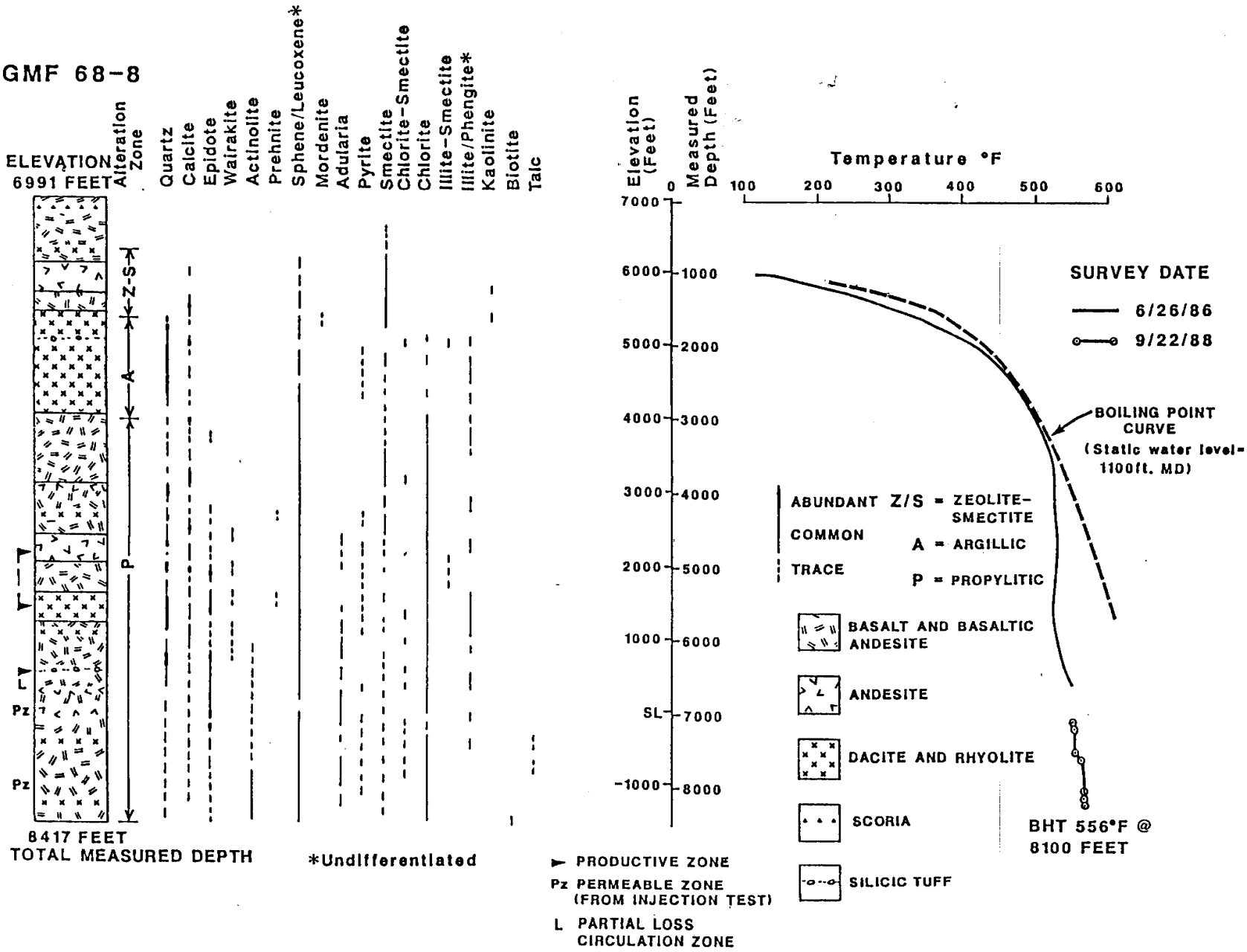



Figure 3: Lithology, alteration zones, mineralogy, and downhole temperatures for GMF68-8. The 6/26/86 temperature survey was taken after the well was static for 311 days. The 9/22/88 temperature survey was taken after the well was deepened and four days after a 32-hour flowtest.

D.L.C. 7/89
UCA07.2701

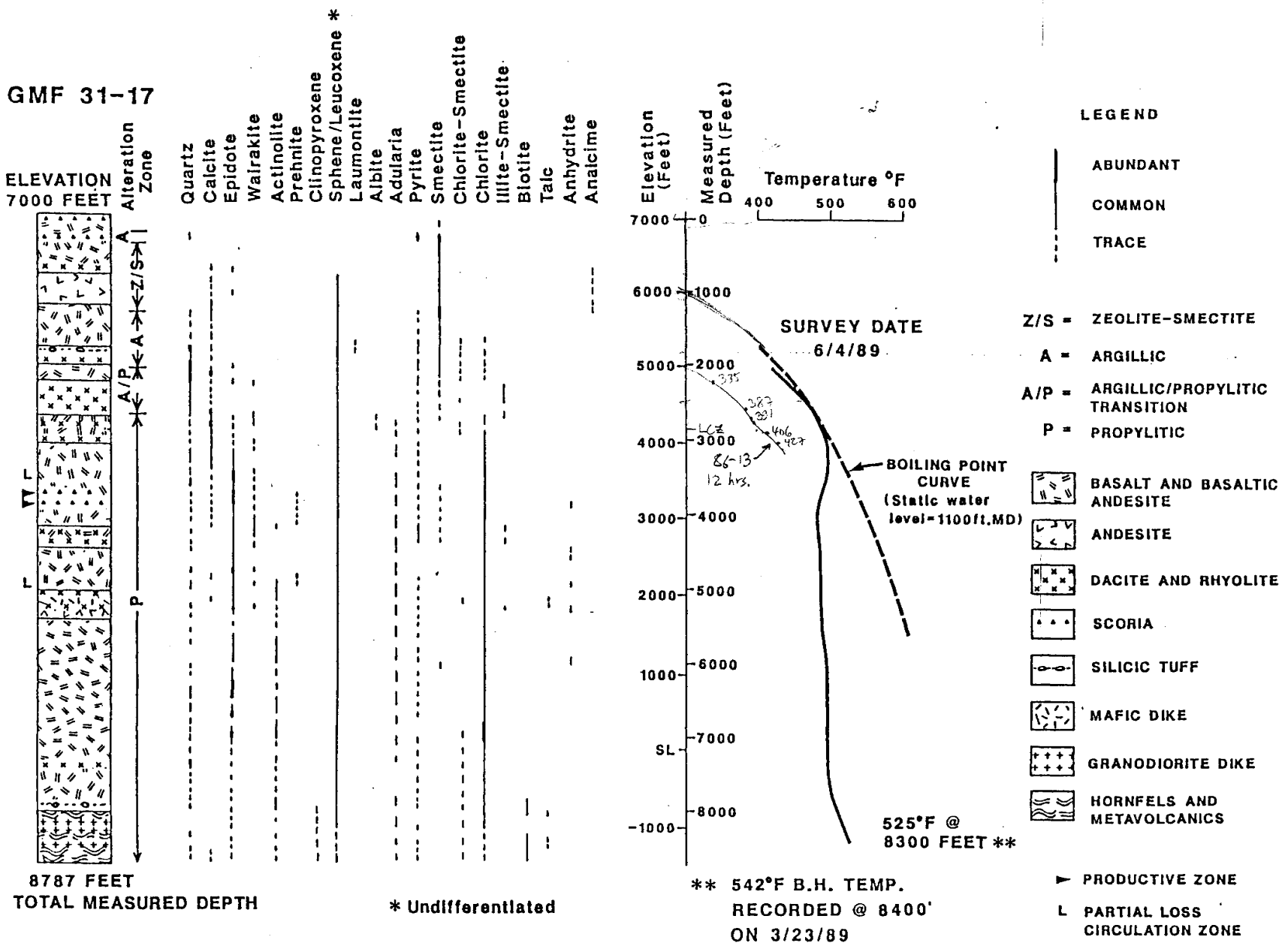
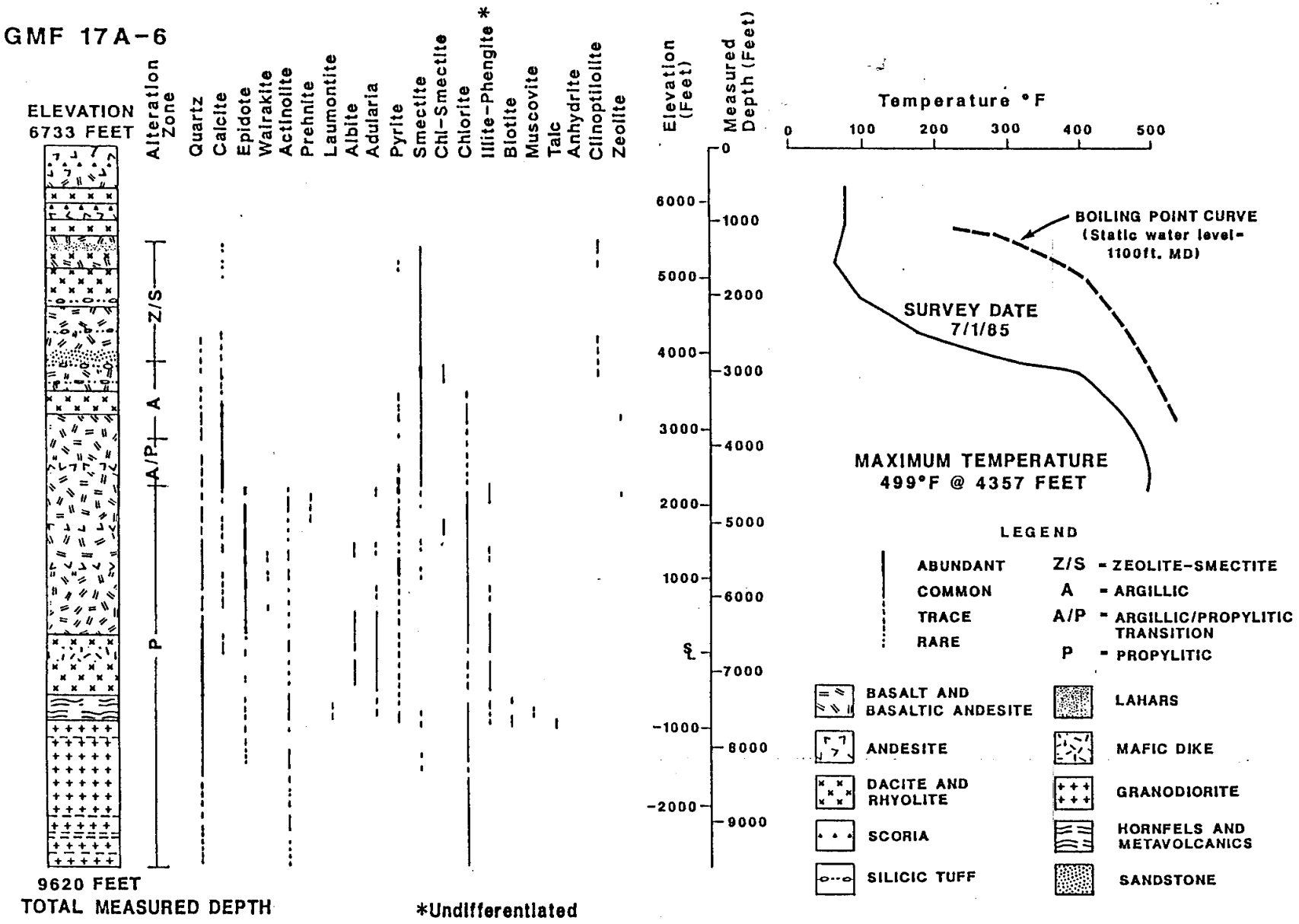



Figure 4: Lithology, alteration zones and mineralogy, and downhole temperatures for GMF31-17. The 6/4/89 survey of GMF31-17 was taken after the well had been static for 247 days.

D.L.C. 7/89
UCA07.2701




D.L.C. 7/89
UCA07.2701

Figure 5: Lithology, alteration zones and mineralogy, and downhole temperatures for GMF17A-6. No stabilized temperature data are available for depths greater than 4550 feet.

hydrothermal minerals with temperature is shown in Figure 6. Although the influence of rock type on an alteration assemblage is greatest at lower temperatures, it becomes an almost insignificant factor when formation temperatures exceed 500°F as in GMF68-8 (Figures 3 and 6). Permeability controls the intensity of the alteration, and determines the degree to which equilibrium between rocks and reservoir fluids is approached.

Most secondary minerals in the Glass Mountain samples are readily assigned to one of seven hydrothermal mineral groups: silica, carbonate, calcium silicate, phyllosilicate, non-calcium silicate zeolite, feldspar, and oxide-sulfate-sulfide. Members of each group and their mode of occurrence are shown in Table 1. Two of the most diagnostic hydrothermal mineral groups are calcium silicates and phyllosilicates, and they are discussed in further detail below.

Calcium Silicates

The calcium silicate minerals observed include epidote, actinolite, prehnite, clinopyroxene, sphene, and the zeolites wairakite, laumontite, and mordenite. Epidote and actinolite are the most common calcium silicate minerals, and wairakite is the most common zeolite. A cross-section depicting the distribution of epidote, actinolite and wairakite in the three wells is shown in Figure 7. Prehnite and hydrothermal clinopyroxene are found in the wells, but are rare. Sphene is problematic since the mineral can occur as both a primary and an alteration mineral. In addition, the XRD patterns of sphene and leucoxene, which is an iron-titanium-oxide alteration product of ilmenite, are difficult to distinguish.

Epidote is the most important calcium silicate for two reasons: its occurrence in active geothermal fields is frequently associated with the top of the reservoir, and it is easily distinguishable with a binocular microscope. Epidote is first observed in GMF68-8 and GMF17A-6 at temperatures exceeding 495°F, which is higher than the 460°F onset for epidote in several other fields (Brown, 1978). However, hydrothermal epidote is also observed to exist in an equilibrium assemblage with other alteration minerals at temperatures as low as 430°F in GMF31-17. Epidote occurs as open space fillings in fractures and vugs and as a replacement of primary plagioclase. Epidote becomes the dominant hydrothermal calcium silicate at 2740 feet in GMF31-17, 4120 feet in GMF68-8, and 4520 feet in GMF17A-6. The mineral is most abundant in GMF31-17, where XRD data show concentrations as great as 26 weight percent of the rock at 3760 to 3900 feet and 5230 to 5240 feet, and 23 weight percent of the rock at 5780 to 5840 feet. Anomalous traces of hydrothermal epidote were identified in lavas of GMF31-17 at 800 and 1100 feet in a lower-temperature assemblage consisting of zeolites and smectite clay. The epidote is not in equilibrium with the zeolite-smectite assemblage.

TABLE 1 Hydrothermal mineral groups and their mode of occurrence as observed in Glass Mountain Wells GMF68-8, GMF31-17 and GMF17A-6

| Mineral Group | Mode of Occurrence: veins & vugs | Mode of Occurrence: replacement | Associated Veinlet Minerals | Primary Minerals Replaced | Comments |
|---|---|---|---|---|---|
| 1. SILICA | | | | | |
| Quartz (QTZ) | X | | CAL, EP, ACT, WAIR, PREH, SPH, CHL, ILL, PHG, BTE, KF, OLIG, PY, MAG, HEM, ANH | | most common hydrothermal mineral |
| Cristobalite (CRIS) | | X | | (glass) | devitrification product |
| Chalcedony (CHAL) | X | | CHL, PHG | | rare in occurrence |
| 2. CARBONATE | | | | | |
| Calcite (CAL) | X | X | QTZ, EP, WAIR, CHL PHG, PLAG, HEM | | replace vein EP & WAIR at 2840/60 ft. in GMF31-17 |
| Aragonite (ARAG) | X | X | | | replaces secondary cristobalite, usually in vugs |
| 3. CALCIUM SILICATE | | | | | |
| Epidote (EP) | X | X | QTZ, CAL, ACT, WAIR, PREH, CHL, PGH, BTE, AB, KF, ANH, HEM | plagioclase | includes clinozoisite |
| Actinolite (ACT) | X | X | QTZ, EP, PREH, SPH, CHL, BTE, TLC, KF, MAG | pyroxene, hornblende | Fe content increases with depth |
| Wairakite (WAIR) | X | X | QTZ, EP, CAL, CHL, AB, KF | plagioclase | zeolite |
| Prehnite (PREH) | X | | QTZ, EP, ACT, CHL, PGH, KF, ANH, HEM | | relatively rare in G.M. rocks |
| Clinopyroxene (CPX) | X | | QTZ, OLIG | | also occurs as a contact metamorphic mineral |
| Sphene (SPH) | X | | QTZ, EP, ACT, KF, MAG | | also occurs as a primary mineral |
| Laumontite (LAU) | X | | | | zeolite |
| Mordenite (MOR) | X | | | | zeolite |

TABLE 1 Continued

| Mineral Group | Mode of Occurrence: veins & vugs | Mode of Occurrence: replacement | Associated Veinlet Minerals | Primary Minerals Replaced | Comments |
|---|---|---|---|---|---|
| 4. PHYLLOSILICATE | | | | | |
| Smectite (SM) | X | X | ANAL, PY | | most common low-temperature clay |
| Kaolinite (KAO) | X | | | | |
| Chlorite (CHL) | X | X | QTZ, CHAL, CAL, EP, WAIR, PREH, ILL, PHG, HEM, LEU | pyroxene, amphibole, biotite | most common high-temperature clay |
| Illite/Phengite (ILL/PHG) | X | X | QTZ, CHAL, CAL, EP, WAIR, CHL, PY, HEM | | differentiated in thin section but not in XRD |
| Chlorite-Smectite (mixed-layer) (C-S) | X | X | | | chlorite content increases with temperature |
| Illite-Smectite (I-S) | X | X | | | illite content increases with temperature |
| Biotite (BTE) | X | X | QTZ, ACT, TLC | amphibole | |
| Muscovite (MUS) | X | X | | feldspars | |
| Talc (TLC) | X | | ACT, BTE | | |
| 5. NON-CALCIUM SILICATE ZEOLITE | | | | | |
| Analcime (ANAL) | X | | SM | | low-temperature zeolite |
| Clinoptilolite (CLIN) | X | | | | low-temperature zeolite |
| 6. FELDSPAR | | | | | |
| Albite (AB) | X | X | QTZ, WAIR, KF | plagioclase | |
| Oligioclase (OLIG) | X | | QTZ, CPX | | gives way to anorthoclase |
| Adularia (KF) | X | X | QTZ, EP, ACT, WAIR, PREH, SPH, CHL, AB, MAG, LEU | plagioclase | |

TABLE 1 Continued

| Mineral Group | Mode of Occurrence: veins & vugs | Mode of Occurrence: replacement | Associated Veinlet Minerals | Primary Minerals Replaced | Comments |
|---|---|---|---|---|---|
| 7. OXIDE-SULFATE-SULFIDE | | | | | |
| Pyrite (PY) | X | | QTZ, EP, CHL, SM, ILL, KF, LEU | | |
| Anhydrite (ANH) | X | | QTZ, EP, PREH | | |
| Magnetite (MAG) | X | | QTZ, EP, ACT, SPH, KF | | also a common primary mineral |
| Hematite (HEM) | X | | QTZ, CAL, CHL | | also a weathering product |
| Geothite (GEO) | X | X | HEM | primary magnetite | |
| Leucoxene (LEU) | X | | QTZ, EP, WAIR, CHL, KF, PY | | indistinguishable from sphene in XRD |



DLC/jmf/5368T

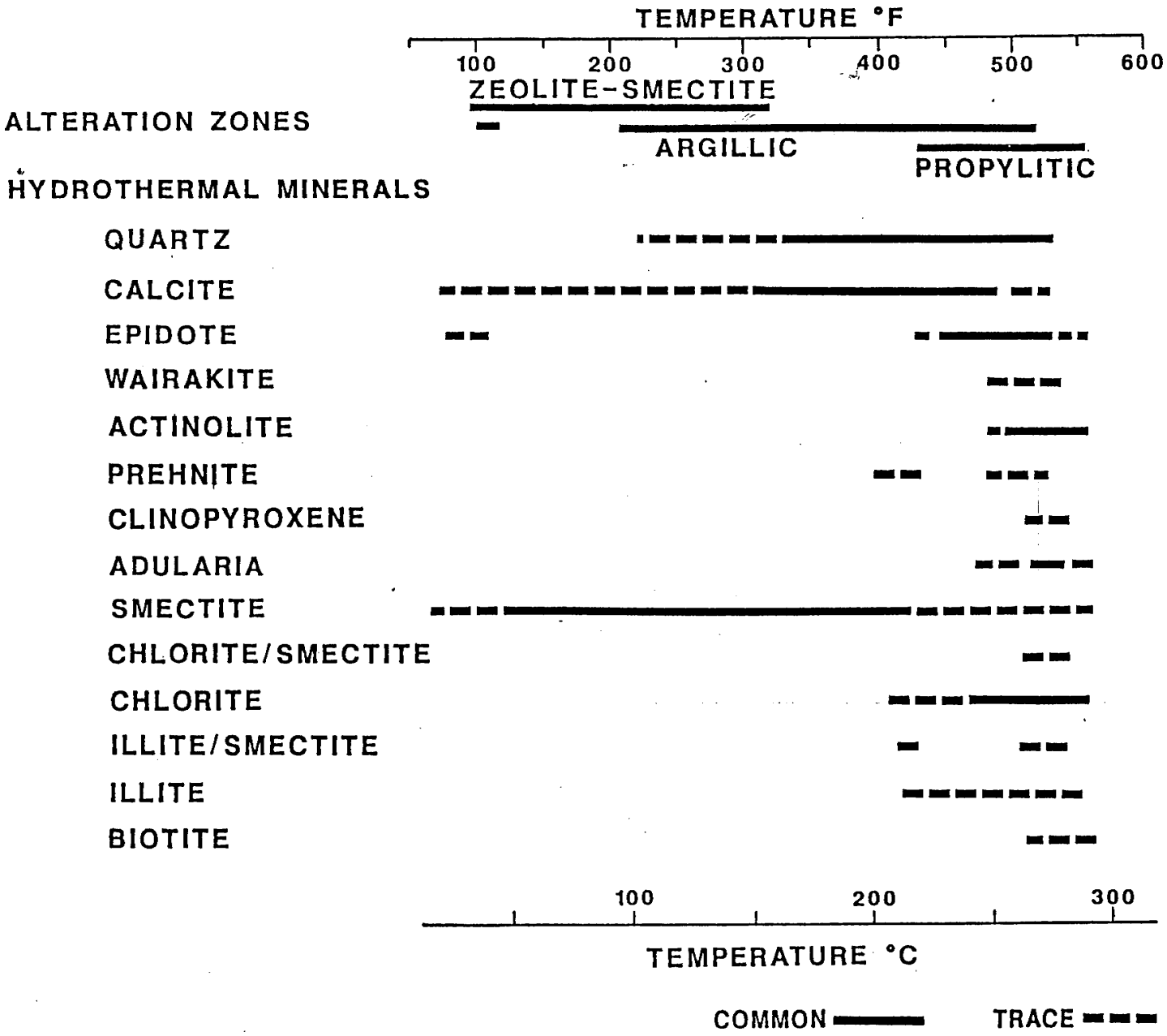



Figure 6: Temperature ranges for the occurrence of hydrothermal minerals and alteration zones in Glass Mountain deep wells. No temperature data are available for depths greater than 4550 feet in GMF17A-6.

D.L.C. 7/89
UCA07.2701

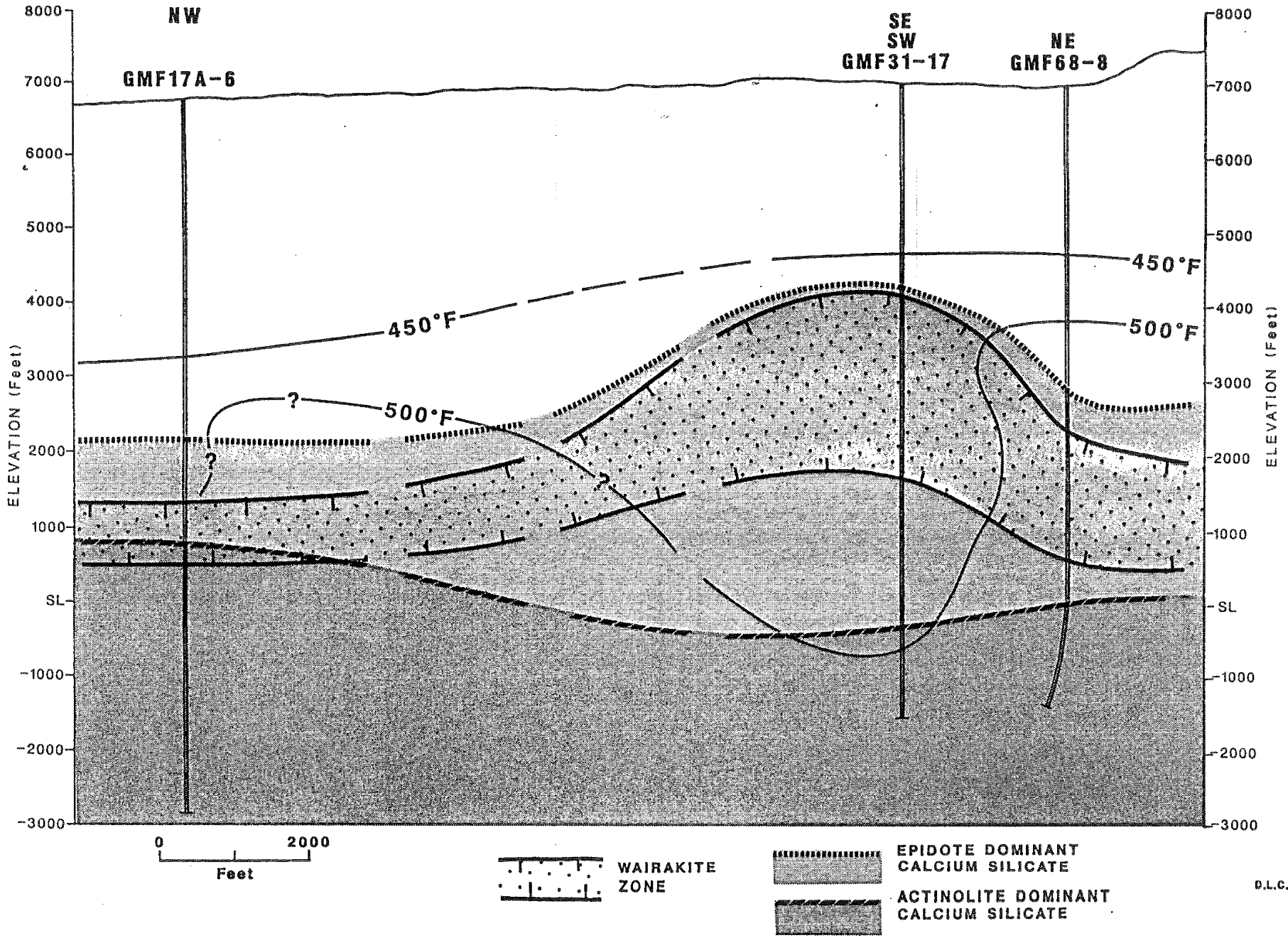



Figure 7: Cross-section showing the distribution of calcium silicate minerals epidote, actinolite and wairakite and subsurface temperatures as observed in Glass Mountain deep wells.

Actinolite is the second most common hydrothermal calcium silicate mineral observed in the wells, and is observed at temperatures greater than 480°F. The mineral first occurs at depths of 4220 feet in GMF31-17, 6400 feet in GMF68-8, and 4620 feet in GMF17A-6. It occurs as an alteration product of pyroxene and hornblende, and in veins commonly containing quartz, adularia and epidote. Actinolite replaces epidote as the dominant calcium silicate at depths below 7460 in GMF31-17, 6940 feet in GMF68-8, and 5950 feet in GMF17A-6. Below 8030 feet in GMF31-17, actinolite is also observed in veins containing talc and biotite (Table 1).

The calcium silicate zeolite, wairakite, is observed only at depths between 2800 and 6400 feet and at temperatures between 479 and 535°F. The mineral occurs in veins with quartz, epidote, adularia, and chlorite, and as an alteration product of plagioclase. As much as seven weight-percent of wairakite is observed at 2840 to 2860 feet in GMF31-17; however calcite is replacing both wairakite and epidote at this depth. The zeolite is least common in GMF17A-6, where it has only a spotty occurrence at 5400 to 6200 feet.

Most of the secondary clinopyroxene observed in GMF31-17 and GMF17A-6 formed as contact metamorphic minerals. Hydrothermal clinopyroxene does occur as a vein mineral in association with quartz and oligoclase at 8090 feet and 8421 feet in GMF31-17. It is uncertain whether the veins formed as part of a hydrothermal event closely following the metamorphic event, or as part of the present hydrothermal system. The veins of clinopyroxene in GMF31-17 are found at present-day temperatures as low as 515°F. Reported occurrences of clinopyroxene in other active geothermal systems are at temperatures in excess of 572°F (Bird, and others, 1984).

Phyllosilicates

The phyllosilicate group of alteration minerals consists of micas, clays, and talc. Hydrothermal micas observed in the wells include both biotite and rare muscovite. The clay minerals include smectite, chlorite, illite, phengite, kaolinite and mixed-layer chlorite-smectite and illite-smectite. Illite and phengite are both potassium-bearing clays that have similar x-ray diffraction patterns and have not been differentiated in this study. Illite and biotite also have similar x-ray diffraction patterns, and have been distinguished by using thin section analysis.

The hydrothermal clays are hydrous minerals and their formation is temperature-dependent. Temperature stability ranges for clays and other phyllosilicates are shown in Table 2. Clay minerals in the wells (Figure 6) occur at temperatures generally consistent with their stability ranges. The exception is smectite, which is observed at temperatures as

TABLE 2 Temperatures of occurrence, reported formation temperatures, and temperature stability ranges for selected hydrothermal phyllosilicate minerals

| HYDROTHERMAL PHYLLOSILICATE MINERALS | TEMPERATURES OF OCCURRENCE AT GLASS MTN. (°F) | REPORTED FORMATION TEMPERATURES AND TEMPERATURE STABILITY RANGES (°F) | REFERENCE |
|---|---|---|---|
| Smectite | 70 to 556* | 86 to 284** | Browne (1984) |
| Kaolinite | 190 to 300 | 122 to 302 | Browne (1978) |
| Chlorite | 483 to 556 | >446 | Browne (1978) |
| Illite/Phengite | 450 to 535 | >428 | Browne (1984) |
| Chlorite-Smectite | 375 to 542 | 392 to 518 | Browne (1978) |
| Illite-Smectite | 375 to 494 | 284 to 428 | Browne (1984) |
| Biotite | 511 to 556 | >428*** | Hulen and Nielson (1986) |
| Talc | 485 to 546 | no data | |



* maximum temperature recorded in any of the wells
** does not include saponite (see Eberl, and others, 1978)
*** more commonly above 572°F (Elders, and others, 1981; Hulen and Nielson, 1986).

DLC/jmf/5368T

high as 556°F in GMF68-8. Only the magnesium rich smectite saponite is stable at these temperatures. If the smectite identified in GMF68-8 is not saponite, then the existence of the smectite at such high temperatures suggests the rocks have low matrix permeability, and there is insufficient water for the smectite to react and form higher-ordered clays.

Smectite and chlorite are the most common clays observed in the wells (Figures 3, 4, and 5). Hydrothermal smectite forms primarily as a low-temperature alteration product of rocks high in magnesium and calcium and low in potassium (Deer, and others, 1975). Mafic lavas containing minerals high in magnesium and calcium alter readily to smectite at low temperatures and under saturated conditions. The alteration of high-potassium silicic rocks, however, tends to yield kaolinite and illite clays rather than smectite. The occurrence of smectite in the wells therefore generally follows the distribution of mafic rocks. Smectite is the most common clay observed at lower temperatures and in the upper 3000 feet of GMF68-8 and GMF31-17 and in the upper 4000 feet of GMF17A-6. At greater depths and temperatures, hydrothermal chlorite becomes the dominant clay. Chlorite formed at Glass Mountain as an alteration product of primary ferromagnesian minerals such as pyroxene, amphibole and biotite. Mixed-layer chlorite-smectite formed as an intermediate mineral between chlorite and smectite. The percentage of chlorite in the mixed-layered clays is observed to increase with temperature.

Hydrothermal biotite first occurs at 8409 feet in GMF68-8, 7900 feet in GMF31-17, and 7400 feet in GMF17A-6. The biotite occurs in GMF31-17 as a vein mineral together with actinolite and talc. In GMF17A-6 the biotite occurs as a ragged replacement of metamorphic mafic minerals in the hornfels, and in well-defined cross-cutting veinlets.

## ALTERATION ZONES

Alteration zoning is well-developed in the Glass Mountain wells. Diagnostic assemblages of hydrothermal minerals are classified into three distinctive types or zones: zeolite-smectite, argillic, and propylitic. The classification is a modification of those presented by Rose and Burt (1979), Kristmannsdottir (1982), Guilbert and Park (1985), and Carrier (1987), and is based on observed mineralogy. Zeolite-smectite alteration is defined here by the presence of either low-temperature zeolites or hydrothermal smectite clay in concentrations greater than three percent of the whole-rock. Argillic alteration is defined by the presence of hydrothermal quartz and either hydrothermal smectite or kaolinite. Propylitic alteration begins when any two of the following four secondary minerals are present: albite, epidote, calcite (replacing plagioclase), and chlorite (greater than smectite). A cross-section showing the distribution of alteration zones in

the wells is presented in Figure 8. The boundaries between the alteration zones are not always sharp. A transition zone is observed in GMF31-17 and GMF17A-6 between the argillic and propylitic alteration zones. Rocks in the transition zone have diagnostic minerals of both alteration assemblages.

The zeolite-smectite zone is found at 380 feet in GMF31-17, 700 feet in GMF68-8, and 1280 feet in GMF17A-6. The top of the zone is probably determined by lithology and the pre-existing water table in the area. At 1280 feet in GMF17A-6, the zeolite-smectite zone is anomalously deep relative to the present static water level in the well of about 1100 feet.

The argillic alteration zone occurs beneath the zeolite-smectite zone at 1320 feet in GMF31-17, 1640 feet in GMF68-8, and 2680 feet in GMF17A-6. Well-developed argillic alteration zones are found in GMF68-8 and GMF31-17, and coincide with observed boiling-point formation temperatures (Figures 3 and 4). Only weak to moderately developed argillic alteration is found in GMF17A-6, a well in which formation temperatures are considerably less than boiling (Figure 5). Argillic alteration in GMF68-8 becomes moderate to strong in intensity at 2080 to 2780 feet, and persists to 3000 feet. Argillic alteration in GMF31-17 occurs at 1320 feet, becomes moderate to strong in intensity at 1780 feet, and persists to at least 2100 feet. A zone of weak argillic alteration occurs in GMF31-17 at the anomalously shallow depth of 260 to 380 feet, and is possibly related to ancient hot spring activity. Argillic alteration in GMF17A-6 begins at 2680 feet, does not progress beyond weak to moderate in intensity, and persists to 3900 feet.

The propylitic alteration zone is first observed at 2740 feet in GMF31-17, 3000 feet in GMF68-8, and 4500 feet in GMF17A-6, and extends to the total depth of each well. Propylitic alteration is well-developed from its first occurrence in GMF31-17 and GMF17A-6, and becomes well-developed at 4120 feet in GMF68-8. Strong propylitic alteration is often observed in cutting samples to be associated with the brecciated zones at the tops and bottoms of lava flows, and in intervals of known production. In the spot cores, strong propylitic alteration is observed to line subvertical fractures and open spaces.

Transition zones are observed in GMF31-17 and GMF17A-6 between argillic and propylitic alteration. The transition zone in GMF31-17 occurs at 2100 to 2740 feet in silicic rocks, and is characterized by mixed-layered clays and the spotty occurrence of poorly crystallized epidote and chlorite. The occurrence of the transition zone is probably due to lithology. Silicic rocks as a whole are not as conducive as mafic rocks to the formation of epidote or chlorite. The transition zone in GMF17A-6 occurs at 3900 to 4500 feet. Although temperatures in the zone exceed 450°F (Figure 5) and chlorite is present, the chlorite remains subordinate to smectite. The transition zone in GMF17A-6 probably results from low matrix permeability which allows the smectite to exist at higher temperatures.

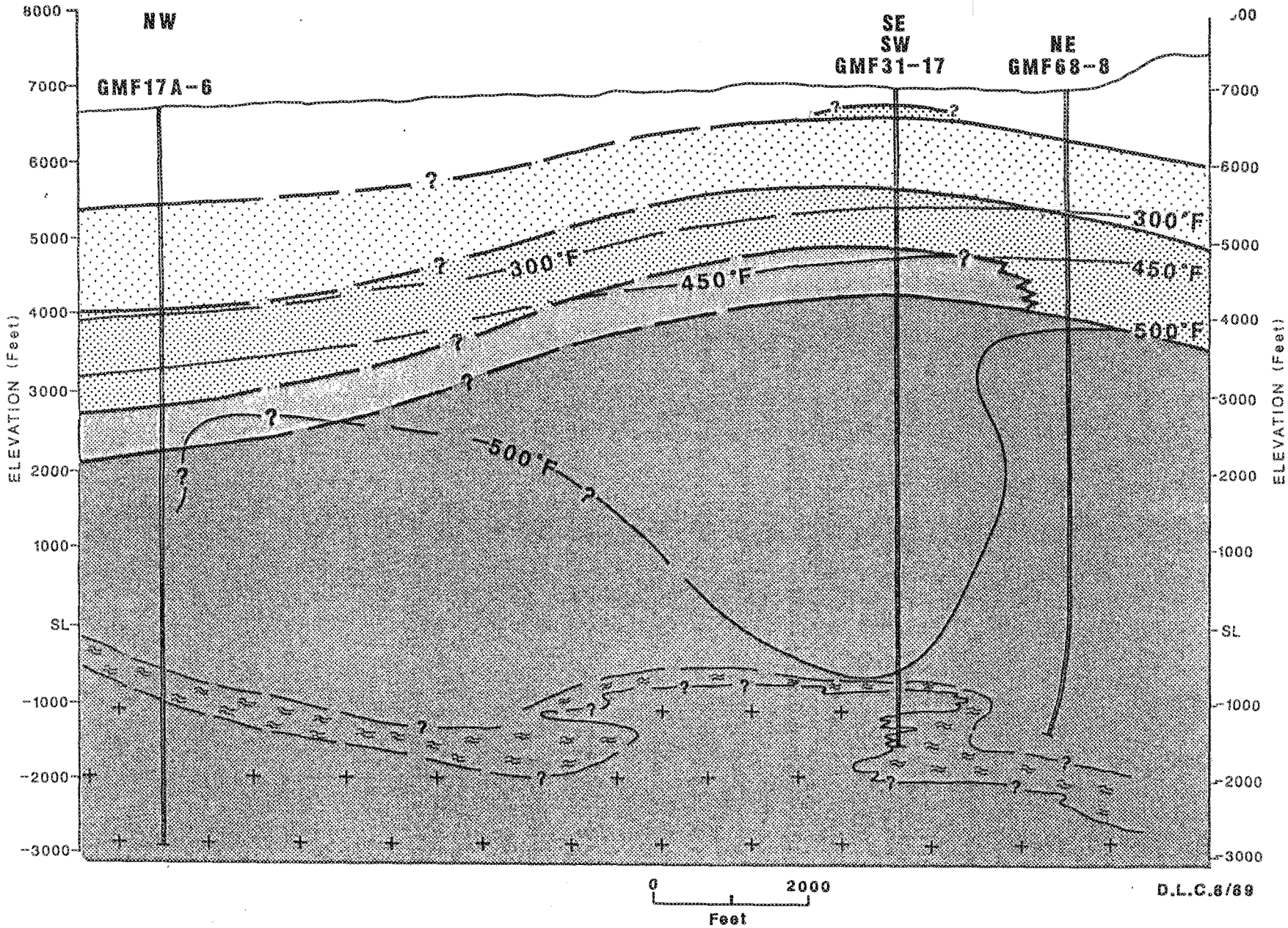



Figure 8: Cross-section showing generalized geology, alteration zones, and subsurface temperatures as observed in the Glass Mountain deep wells.

A good correlation is observed to exist between alteration zones and modelled low-resistivity anomalies (Figure 9). The resistivity data are compiled from one-dimensional inversions of time-domain electromagnetic (TDEM) and magnetotelluric (MT) data. Modelled low-resistivities in general coincide with the zones of argillic alteration and are believed to be associated with smectite clay (Nordquist, 1986). The lowest resistivities are modelled for the GMF31-17 and GMF68-8 areas, at which moderate to strong argillic alteration and boiling-point formation temperatures exist. Modelled resistivities in the GMF17A-6 area are not as low as at GMF31-17 and GMF68-8. In GMF17A-6, only weak to moderate argillic alteration and less than boiling-point formation temperatures are observed.

## CONCLUSIONS

The deep well data show that reservoir rocks at Glass Mountain are dominantly layered volcanics. Primary permeability therefore probably has a much higher horizontal component than a vertical component. The thick sequence of volcanic rocks indicates that the area has had a long volcanic history. Further work is needed to substantiate the preliminary conclusion that the coarser grained volcanics observed at depths of 4600 feet mark the base of Medicine Lake volcano. The apparent depression of the pre-Medicine Lake lavas can be attributed to some combination of three factors: paleotopography, volcanic subsidence, or isostatic compensation. The absence of massive tuffs underlying the caldera floor indicates no catastrophic eruption of pumice and ash has occurred. Any subsidence is therefore probably the result of isostatic compensation.

The mineralogical data suggest that either multiple hydrothermal systems have existed in the Glass Mountain area, or that temperatures in the present geothermal system have declined. This is evident by the occurrence of epidote at an anomalously low temperature of 430°F at 2840 to 2860 feet in GMF31-17. Caution is therefore needed in using the first occurrence of epidote to identify the top of the reservoir. In addition, the replacement of epidote and wairakite by calcite at 2840 to 2860 feet in GMF31-17 is indicative of boiling and $CO_2$ exsolution. These processes are consistent with the boiling-point temperatures currently observed at those depths (Figure 4). In addition to epidote, hydrothermal clinopyroxene also appears at lower-than-expected temperatures in GMF31-17. The clinopyroxene-quartz-oligoclase and biotite-actinolite-talc veins in the contact metamorphic rocks in GMF31-17 and GMF17A-6 possibly record high-temperature hydrothermal alteration that closely followed the metamorphism. Fluid inclusion data will be useful in resolving these relationships further.

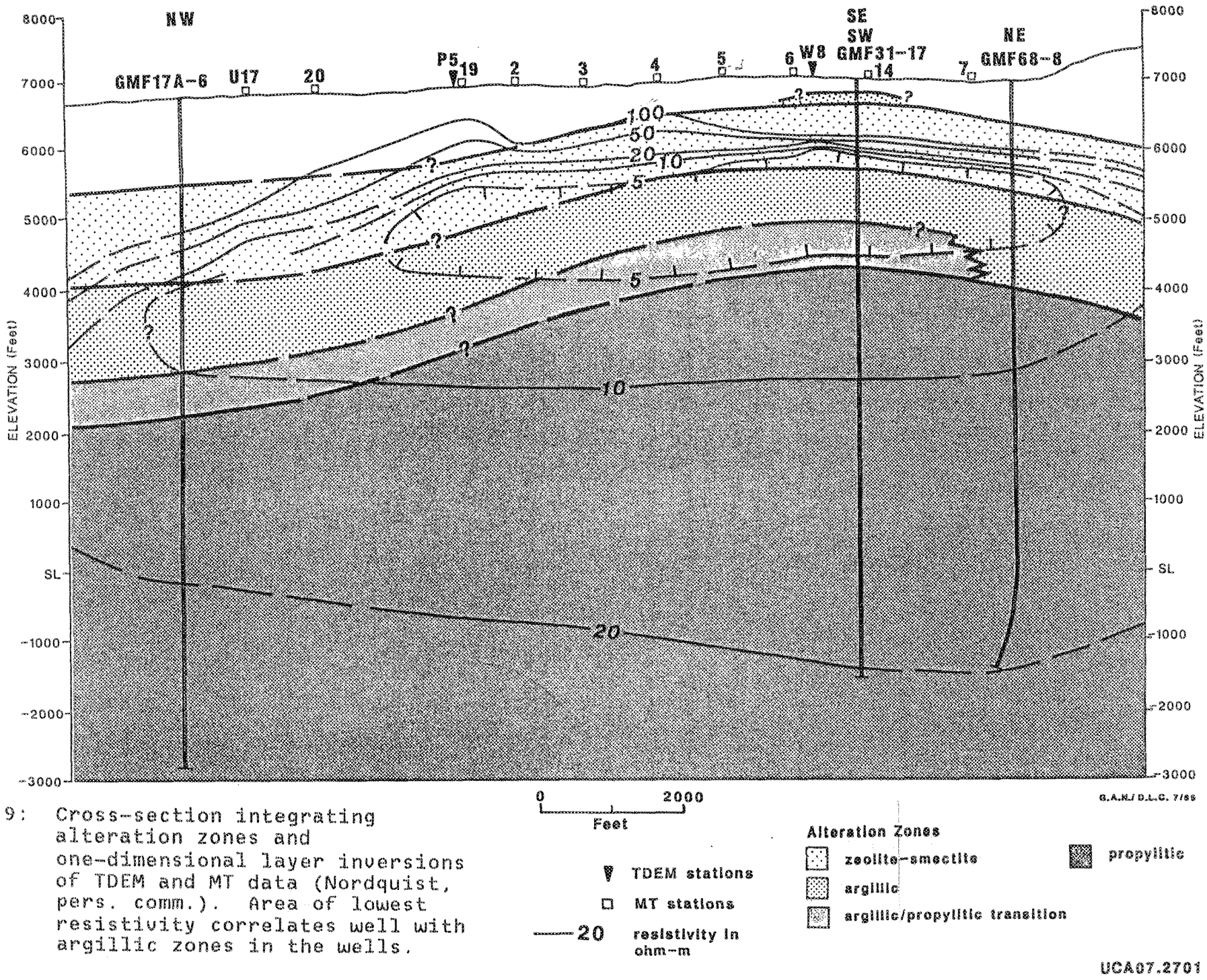



Figure 9: Cross-section integrating alteration zones and one-dimensional layer inversions of TDEM and MT data (Nordquist, pers. comm.). Area of lowest resistivity correlates well with argillic zones in the wells.

The systematic pattern of alteration zoning in the wells indicates a well-developed geothermal system has existed in the Glass Mountain area. Strong argillic alteration in GMF31-17 and GMF68-8 is due to the upwelling of thermal fluids in the area to levels where boiling occurs (Figures 3, and 4,). Similar upwelling or boiling of thermal fluids do not appear to have occurred in the GMF17A-6 area (Figure 5). TDEM and MT have been shown to be useful in the Glass Mountain area for predicting the occurrence of strong argillic alteration. The anomalously shallow weak argillic alteration at 260 feet in GMF31-17, together with the occurrence of epidote and wairakite at 2840 to 2860 feet, suggests that past hydrostatic water levels in the area have been shallower than the current 1100 feet. The occurrence of strong propylitic alteration along fractures and the brecciated tops and bottoms of lava flows suggests that these areas are a preferred pathway for geothermal fluids.

DLC/jmf/5285T
Ctlg. No.: UCA07.2701

## REFERENCES


Anderson, C.A., 1941, Volcanoes of the Medicine Lake Highland, California. Univ. Calif. Publ. Bull. Dep. Geol. Sci., 25, p. 347-422.

Bird, D.K., Schiffman, P., Elders, W.A., Williams, A.E., and McDowell, S.D., 1984, Calc-Silicate mineralization in active geothermal systems. Economic Geology, v. 79, p. 671-695.

Brown, P.R.L., 1978, Hydrothermal alteration in active geothermal fields. Ann. Rev. Earth Planet. Sci., v. 6, p. 229-50.

Brown, P.R.L., 1984, Lectures on geothermal geology and petrology: United Nations Univ., Geoth. Training Prog., Rept. 1984-2, 92p.

Carrier, D.L., 1987, Analysis of mineralogy and fluid inclusion data from Glass Mountain Area temperature boreholes. UNOCAL Memorandum, 22 p.

Deer, W.A., Howie, R.A., and Zussman, J., 1975, An Introduction to the Rock Forming Minerals. Eighth edition, Longman Group Limited, London, p. 269.

Donnelly-Nolan, J.M., 1988, A magmatic model of Medicine Lake Volcano. California, Jour. Geophys. Res., v. 93, p. 4412-4420.

Eberl, D., Whitney, G., and Khoury H., 1978, Hydrothermal reactivity of smectite. American Mineralogist, v. 63, p. 401-409.

Elders, W.A., Hoagland, J.R., and Williams, A.E., 1981, The distribution of hydrothermal mineral zones in the Cerro Prieto geothermal field of Baja California, Mexico. Geothermics, v. 10, p. 245-253.

Guilbert, J.M., and Park, C.F., Jr., 1986, The Geology of Ore Deposits. W.H. Freeman and Company, New York, p. 180-197.

Hausback, B.P., 1984, Surficial Geology of the Medicine Lake Highland. UNOCAL Memorandum, 20p.

Heiken, G., 1978, Plinian-type eruptions in the Medicine Lake Highland California, and the nature of the underlying magma. J. Volcanol. Geotherm. Res., v. 4, p. 375-402.

Hulen, J.B., and Nielson, D.L., 1986, Hydrothermal alteration in the Baca geothermal system, Redondo Dome, Valles Caldera, New Mexico. Jour. Geophys. Res., v. 91, No. B2, p. 1867-1886.

Kristmannsdottir, H., 1982, Alteration in the IRDP drill hole compared with other drill holes in Iceland. Jour. Geophys. Res., v. 87, p. 6525-6531.

Mertzman, S.A., 1982, K-Ar results for silicic volcanics from the Medicine Lake Highland, Northeastern California - a summary. Isochron/West, no. 34, p. 3-7.

Mertzman, S.A., 1983, An addendum to "K-Ar results for silicic volcanics from the Medicine Lake Highland, Northeastern California - a summary." Isochron/West, no. 38, p. 3-5.

Nordquist, G.A., 1986, Interpretation of the 1985 detailed TDEM survey in the Glass Mountain Unit Area. UNOCAL Memorandum, 5 p.

Rose, A.W., and Burt, D.M., 1979, Hydrothermal Alteration, Geochemistry of Hydrothermal Ore Deposits. H.L. Barnes, ed., John Wiley & Sons, New York, p. 173-235.

DLC/jmf/5285T
Ctlg. No.: UCA07.2701

# APPENDIX 1

# XRD ANALYSES

KEY FOR XRD ANALYSES
PRESENT IN APPENDIX I

| WELL | SAMPLE NO. | DEPTH (FEET) |
|---|---|---|
| GMF17A-6 | 6-1 | 7690-7700 |
| | 6-2 | 7160-70 |
| | 6-3 | 6820-30 |
| | 6-4 | 5710-20 |
| | 6-5 | 5260-70 |
| | 6-6 | 4620-30 |
| | 6-7 | 4910-20 |
| | 6-8 | 8230-40 |
| GMF68-8 | 8-1 | 6460-80 |
| | 8-2 | 6140-60 |
| | 8-3 | 5840-60 |
| | 8-4 | 5400-20 |
| | 8-5 | 4660-80 |
| | 8-6 | 4120-40 |
| | 8-7 | 3200-20 |
| | 8-8 | 2660-2680 |
| | 8-9 | 6940-50 |
| | 8-10 | 7070-80 |
| | 8-11 | 7300-10 |
| | 8-12 | 7700-10 |
| | 8-13 | 7890-7900 |
| | 8-14 | 8060-70 |
| | 8-15 | 8160-70 |
| | 8-16 | 6593 |
| | 8-17A | 8409 |
| | 8-17B | 8413 |
| | 8-18 | FLOW LINE SAMPLE |
| GMF31-17 | 17-1 | 800-10 |
| | 17-2 | 1100-10 |
| | 17-3 | 1300-10 |
| | 17-4 | 1790-1800 |
| | 17-5 | 2100-20 |
| | 17-6 | 2300-20 |
| | 17-7 | 2840-60 |
| | 17-8 | 3240-60 |
| | 17-9 | 3870-80 |
| | 17-10 | 4220-30 |
| | 17-11 | 4480-90 |
| | 17-12 | 4940-50 |
| | 17-13 | 5230-40 |
| | 17-14 | 5320-30 |
| | 17-15 | 5780-90 |
| | 17-16 | 6080-90 |
| | 17-17 | 6560-70 |
| | 17-18 | 7020-30 |
| | 17-19 | 7450-60 |
| | 17-20 | 8030-40 |
| | 17-21 | 8090-8100 |
| | 17-22 | 8250-60 |
| | 17-23 | 8787 |
| | 17-24 | 8420 |
| | 17-25 | 8422 |

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

January 23, 1985

Richard Gunderson, Geologist
Union Oil Company of California
Union Geothermal Division
2099 Range Avenue
Santa Rosa, CA 95406

Dear Richard:

The 31 Geysers area cuttings samples you recently submitted to our lab have been mineralogically analyzed by qualitative X-ray diffraction (XRD). Results of the analyses, a summary of methods by which the analyses were obtained, and all corresponding diffractograms accompany this letter.

Well 17A-6, from which 30 of the samples were obtained, is shown by XRD to be distinctly zoned mineralogically. Smectite is confined to the interval between 1400 and 4330 feet (depth). Four samples in this interval contain trace to minor clinoptilolite. The lower part of the smectite zone overlaps a chlorite zone which extends from 3940' to the deepest sample at 9590'. Epidote accompanies chlorite between 4750' and 7720'. Amphibole appears at 4750' and persists to the deepest sample. Mica (probably mostly biotite) is prominent below 7550'.

The upper part of well 17A-6 apparently penetrates interlayered basic and felsic volcanic rocks; the former mostly plagioclase, the latter composed principally of sanidine and cristobalite. These volcanics overlie probable metasedimentary rocks, in turn intruded by mica-amphibole quartz diorite(?). Much of the mineralogic zoning revealed by XRD, therefore, reflects rock type rather than alteration. Smectite, chlorite and epidote, however, are clearly secondary, as is the minor pyrite between 4750' and 6920'. Petrographic examination and clay-fraction XRD might reveal additional alteration phases.

Thank you for submitting these cuttings, and please call if I can clarify any aspect of their XRD mineralogy.

Sincerely,

Jeffrey B. Hulen
Geologist

JBH/jp

BULK XRD

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ✓

| SAMPLE NO. | QUARTZ ✓ | CRISTOBAL. ✓ | TRYDYMITE | PLAGIOCL. ✓ | K-FELDSP. ✓ | CALCITE ✓ | HEMATITE ✓ | ILMENITE ✓ | PYRITE ✓ | ILLITE ✓ | MICA ✓ | CHLORITE ✓ | SMECTITE ✓ | MIXED-LAYER ILLITE-SMEC. ✓ | MIXED-LAYER CHL.-SMEC. ✓ | AMPHIBOLE | EPIDOTE | CLINOPTILOL. | LALMONTITE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KCF 82-15: | | | | | | | | | | | | | | | | | | | | | | |
| FILL BENEATH SHOE | M | | | m | | m | | | TR? | m | | m | | | m | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 17A-6: | | | | | | | | | | | | | | | | | | | | | | |
| 200-230' | | | | M | | | TR? | m | | | | | | | | | | | | | | |
| 620-650' | m | M | m? | TR? | M | | TR | | | | | | | | | | | | | | | |
| 950-980' | | | | M | | | TR | m | | | | | | | | | | | | | | |
| 1400-1430' | m | | | M | | | TR | m? | | | | | m | | | | | m | | | | GLASS (M) |
| 1600-1630' | | | | M | | | TR | m? | | | | | m | | | | | TR | | | | GLASS (M) |
| 1800-1830' | TR | M | m? | m | M | | | TR? | | | | | m | | | | | | | | | |
| 2100-2130' | TR | M | | m | M | | TR | | | | | | m | | | | | | | | | |
| 2400-2430' | | | | M | | | | | | | | | TR | | | | | | | | | GLASS (M) |
| 2750-2780' | | | | M | | | TR | | | | | | m | | | | | TR | | | | |
| 3040-3070' | m | | | M | | | TR | TR? | | | | | M | | m | | | TR | | | | |
| 3400-3430' | M | | | M | | | | m | | | | | m | | | | | | | | | |
| 3940-3970' | m | | | M | | | TR | m | | | | TR* | m | | | | | | | | | |
| 4300-4330' | m | | | M | | | TR? | m? | | | | TR* | m | | | | | | | | | |
| 4750-4780' | m | | | M | | | | | TR | | | m* | | | | | TR | | | | | |
| 5070-5100' | m | | | M | | | | | TR | | | m | | | m | m | m | | | | | |
| 5400-5430' | m | | | M | TR | m | TR | | | | | m | | | | m | m | | | | | |
| 5950-5980' | m | | | M | TR | | TR | | TR | | | m | | | | m | TR | | | | | |
| 6300-6330' | m | | | M | m | | TR | | TR | | | m | | | | m | | | | | | |
| 6600-6630' | M | | | M | m | | TR | | TR | m* | | m | | | | m | TR | | | | | |
| 6900-6930' | M | | | M | m | | | | TR | m* | | m | | | | m | TR | | | | | |

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

* POSSIBLY MICA
* MAY INCLUDE KAOLIN

BULK XRD

MINERALOGY, APPROX. WT.% ☐ (or) RELATIVE ABUNDANCE ☑

| SAMPLE NO. | QUARTZ | CRISTOBAL. | TRIDYMITE | PLAGIOCL. | K-FELDSP. | CALCITE | HEMATITE | ILMENITE | PYRITE | ILLITE | MICA * | CHLORITE | SMECTITE | MIXED-LAYER ILLITE-SMEC. | MIXED-LAYER CHL.-SMEC. | AMPHIBOLE | CLINOPTIL. | ALUNITE | EPIDOTE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7200-7230' | M | | | M | m | | Tr? | | | | | m | | | | m | | | | | | | |
| 7550-7580' | m | | | M | Tr | | Tr? | | | | m | m | | | | m | | m? | | | | | |
| 7710-7720' | M | | | M | m | | Tr? | | | | m | m | | | | m | | | Tr | | | | |
| 7800-7830' | M | | | M | m | | Tr? | | | | m | m | | | | m | | | | | | | |
| 8100-8130' | M | | | M | m | | | | | | m | m | | | | m | | | | | | | |
| 8400-8430' | M | | | M | m | | | | | | m | m | | | | m | | | | | | | |
| 8700-8730' | M | | | M | m | | | | | | m | m | | | | m | | | | | | | |
| 9000-9030' | M | | | M | m | | | | | | m | m | | | | m | | | | | | | |
| 9300-9320' | M | | | M | m | | | | | | m | m | | | | m | | | | | | | |
| 9590-9620' | M | | | M | m | | | | | | m | m | | | | m | | | | | | | |

* MAY INCLUDE MINOR ILLITE

MM = PREDOMINANT M = MAJOR m = MINOR Tr = TRACE ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

# SEMI-QUANTITATIVE MINERALOGIC ANALYSIS BY X-RAY DIFFRACTION

## -Methods and Procedures-

**Bulk Analysis:** Representative one-gram splits of bulk samples are ground in acetone in an agate mortar to <325 mesh (< 45 μ) then scanned at 2°2θ per minute from 2-65°2θ. Diagnostic peaks of minerals identified on resulting diffractograms are re-scanned on duplicate samples. Approximate weight percentages of the minerals are determined by comparing diagnostic peak intensities with those generated by standard pure phases mixed in various known proportions.

**Clay Analysis:** Bulk samples, at least 35 grams if possible, are sonically disaggregated in deionized water, allowed to settle sufficiently to yield the desired particle size fraction (generally < 2 μ or < 5 μ), decanted and centrifuged. The resulting slurries are smeared on glass slides and X-rayed at 1°2θ per minute following air-drying (2-37°), vapor glycolation for 24 hours at 60°C (2-22°), heating to 250°C for one hour (2-15°) and heating to 550°C for one hour (2-15°). Approximate weight percentages of the layer silicates identified on diffractograms corresponding to these treatments are determined by comparison of diagnostic peak intensities with those generated by pure reference clays in appropriate mixtures.

GMF 68-8 (FROM Hueen 1985)

diffractometer using CuKα radiation at the following instrument settings: accelerating voltage - 40 kv; tube current - 40 ma; full-scale deflection - 2500 counts per second; time constant-one second. All samples were irradiated at 1°2θ per minute after the following treatments: air-drying (2-37°2θ), vapor glycolation at 60°C for 24 hours (2-22°2θ), heating to 250°C for one hour (2-15°2θ) and heating to 550°C for one hour (2-15°2θ). Approximate amounts of layer silicates identified on corresponding diffractograms were determined by comparing diagnostic peak intensities with those generated by reference standards.

## Results and Discussion

The 16 samples analyzed comprise principally basalt and andesite, with two samples listed as "tuff or volcaniclastic", one dacite, and one altered silicic flow rock. As expected, plagioclase is the main component of the intermediate- to basic-composition rocks. The plagioclase is accompanied by minor magnetite, ilmenite and hematite, and probably pyroxene. The few and poorly-developed peaks of both clino- and orthopyroxene are masked by the strong and numerous reflections of the abundant plagioclase, and so are difficult to identify reliably; petrographic confirmation is necessary. Above 5000', the intermediate-composition rocks contain minor smectite; below 1200', minor quartz and chlorite and sporadic K-feldspar and calcite are present. Possible traces of analcime or wairakite occur below 4400', and 3% epidote is present in all samples below 4800'.

The rock field-named dacite at 1600' contains appreciable alkali feldspar and may actually be quartz latite or rhyolite. This sample also contains 2% mordenite and 10% smectite, and is probably hydrothermally altered. The altered silicic flow rock at 2200' is very rich in quartz and contains, in addition to minor smectite, 5% illite and 2% chlorite. The "tuff or

ALEX SCHRIENER
NOV 19 1985

volcaniclastic" at 5000' is shown by XRD to be an intermediate-composition rock which has been moderately propylitized.

The clay fractions extracted from the bulk cuttings samples show well-defined layer silicate zoning, probably in response to increasing temperature with depth, either presently or at some time in the past. Smectite and kaolin are strongly concentrated above 1900', below which depth chlorite and minor illite predominate. The rock at 1900' contains smectite-rich interstratified smectite-chlorite; three samples below 1900' contain mixed-layer chlorite-smectite which is much richer in chlorite. If the clay mineral zoning revealed in well 68 reflects the present thermal regime, it may be possible to establish vectors toward heat centers using layer silicate assemblages in combination with other available surface and downhole data.

ALEX SCHRIENER
NOV 19 1985

BULK

MINERALOGY, APPROX. WT.% ☑ (or) RELATIVE ABUNDANCE ☐

| SAMPLE NO. | QUARTZ | CRISTOBALITE | K-FELDSP. | PLAGIOCLASE | CALCITE | MORDENITE | MAGNETITE | ILMENITE | HEMATITE | PYRITE | CLINOPYROXENE (±) ORTHOPYROX. | AMPHIBOLE | EPIDOTE | APATITE | SMECTITE | ILLITE ± MICA | CHLORITE | KAOLIN | ANALCIME OR WAIRAKITE | OTHER * |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68-400 | | | | 62 | | | 2? | 1 | 1 | | | | | | 1 | | | | | 33 |
| 68-800 | | | | 55 | | | | 1 | 2 | | >10? | | | 1? | 6 | | | | | <25 |
| 68-1200 | | | | 58 | | | | 1 | 1 | | >10? | | | 1? | 9 | | | | | <20 |
| 68-1600 | 8 | 15 | 40 | 12 | | 2 | | | 1 | | | | | | 10 | | TR? | TR? | | 12 |
| 68-1900 | 17 | | 5 | 48 | 1 | | | 2 | 3 | | >5? | | | | 5 | | 2 | | | <12 |
| 68-2200 | 40 | | 32 | 17 | | | | | 1 | | | | | | 3 | 5 | 2 | | | |
| 68-3000 | 14 | | 2 | 45 | 7 | | | | 4 | | >10? | | | | 2 | 2 | 6 | | | <8 |
| 68-3400 | 10 | | 1? | 46 | 3 | | | | 4 | | >10? | | | | 5 | | 3 | | | <18 |
| 68-3800 | 8 | | | 48 | | | | 2 | 2 | | >10? | | | 1? | 14 | | 7 | | | <8 |
| 68-4400 | 8 | | | 48 | 8 | | | 1 | 4 | | >10? | | | | 3 | | 8 | | | <10 |
| 68-4800 | 14 | | 2 | 53 | | | | 2 | 2 | | ? | 2 | | | TR | | 5 | | TR? | 20 |
| 68-5000 | 13 | | 2 | 48 | 1 | | | | 2 | | | | 3 | | | | 11 | | | 20 |
| 68-5200 | 9 | | | 53 | 1 | | | | 2 | | | | 3 | | | | 9 | | | 23 |
| 68-5600 | 11 | | 2 | 47 | 3 | | | | 3 | | | | 3 | | | | 4 | | 1? | 26 |
| 68-6000 | 11 | | 1 | 52 | 3 | | | | 3 | | | | 3 | | | | 5 | | 1? | 21 |
| 68-6400 | 12 | | 2 | 55 | 4 | | | | 3 | | | 2 | 3 | | | | 5 | | TR? | 14 |

* INCLUDES AMORPHOUS PHASES, THOSE BELOW DETECTION LIMIT, AND THOSE WHOSE REFLECTIONS ARE MASKED BY PLAGIOCLASE PEAKS. MAY INCLUDE SOME LOST CIRCULATION MATERIAL.

MM = PREDOMINANT M = MAJOR m = MINOR Tr = TRACE ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

ALEX SCHRIENER
UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

NOV 19 1985

CLAY FRACTION

MINERALOGY, APPROX. WT.% ✓ (or) RELATIVE ABUNDANCE ☐

| SAMPLE NO. | SMECTITE | MIXED-LAYER SMECT.-CHLOR. Ⓓ | MIXED-LAYER CHLOR.-SMEC. | CHLORITE | ILLITE | MIXED-LAYER ILLITE-SMEC. Ⓒ | KAOLIN |
|---|---|---|---|---|---|---|---|
| 68-400 | 100 | | | | | | |
| 68-800 | 100 | | | | | | |
| 68-1200 | 97 | | | | | | 3 |
| 68-1600 | 95 | | | | | | 5 |
| 68-1900 | | 40 | | 50 | 5 | 5 | |
| 68-2200 | 55 | | | 10 | 35 | | |
| 68-3000 | | | | 90 | 10 | | |
| 68-3400 | 37 | | | 60 | 3 | | |
| 68-3800 | 65 | | 15 Ⓔ | 20 | | | |
| 68-4400 | 5 | | | 95 | | | |
| 68-4800 | 3 | | | 93 | 4 | | |
| 68-5000 | Tr | | | 98 | 2 | | |
| 68-5200 | | | | 98 | 2 | | |
| 68-5600 | | 5 | | 80 | 15 | | |
| 68-6000 | | | 10 Ⓑ | 75 | 15 | | |
| 68-6400 | | | 5 Ⓔ | 80 | 15 | | |

Ⓐ >75% SMECTITE
Ⓑ 90% CHLORITE
Ⓒ >80% ILLITE
Ⓓ MAY INCLUDE PRIMARY MICA
Ⓔ ±50% CHLORITE

MM = PREDOMINANT M = MAJOR m = MINOR Tr = TRACE ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

ALEX SCHRIENER

NOV 19 1985

KEY FOR XRD ANALYSES
FROM MARCH 16, 1988

| WELL | SAMPLE NO. | DEPTH (FEET) |
|---|---|---|
| GMF17A-6 | 6-1 | 7690-7700 |
| | 6-2 | 7160-70 |
| | 6-3 | 6820-30 |
| | 6-4 | 5710-20 |
| | 6-5 | 5260-70 |
| | 6-6 | 4620-30 |
| | 6-7 | 4910-20 |
| | 6-8 | 8230-40 |

KEY FOR XRD ANALYSES

| WELL | SAMPLE NO. | DEPTH (FEET) |
|---|---|---|
| GMF68-8 | 8-1 | 6460-80 |
| | 8-2 | 6140-60 |
| | 8-3 | 5840-60 |
| | 8-4 | 5400-20 |
| | 8-5 | 4660-80 |
| | 8-6 | 4120-40 |
| | 8-7 | 3200-20 |
| | 8-8 | 2660-2680 |

DAN CARRIER

MAR 2 3 1988

March 16, 1988

Earth Science Laboratory
University of Utah Research Institute
391-C Chipeta Way
Salt Lake City, Utah 84108

Dr. Daniel Carrier
Unocal Geothermal Division
Unocal Corporation
3576 Unocal Place
Santa Rosa, California 95406

Dear Dan:

Attached are tabulated results of XRD analysis and reconnaissance petrographic examination for 16 drill cuttings samples which you submitted in mid-November 1987. These results, initially mailed to you late in December, and which we discussed for several hours by telephone early in 1988, are reiterated and further interpreted in the text which follows.

Eight samples of the "6"-series group are dominated by three principal rock types: hornfels and allied intermediate-composition metavolcanic rock; quartz latite or rhyodacite; and altered basic to intermediate-composition volcanic rocks. The hornfels, restricted to sample 6-1, is essentially a fine-crystalline quartz-plagioclase-biotite rock with minor hornblende and clinopyroxene. Well-developed granoblastic texture is locally present, and a few of the clinopyroxenes are sieve-textured. Many chips, however, although mineralogically similar, lack these well-defined textures, and perhaps could be termed intermediate-composition metavolcanic rocks. Yet other chips are moderately- to well-foliated, and appear to be intermediate between hornfels and phyllite or fine-crystalline schist. Regardless of texture, however, all these rocks appear to have been metamorphosed to amphibolite grade. Hydrothermal biotite and amphibole are also locally present in sample 6-1, but these tend to occur as ragged replacements of metamorphic mafics or in well-defined cross-cutting veinlets. It's possible that sample 6-1 records contact metamorphism closely followed by high-temperature hydrothermal alteration.

Samples 6-2 and 6-3 contain principally chips of quartz latite or rhyodacite, consisting almost entirely of quartz, plagioclase and potassium feldspar (in decreasing order of abundance). This rock type is typically microcrystalline to fine-crystalline and displays well-developed granophyric, micropegmatitic, axiolitic and spherulitic textures. I've observed similar textures in the granophyrically crystallized interiors of the major intracaldera ash-flow sheets of the

Valles caldera. Even where intensely recrystallized, however, these ignimbrites retain at least vestiges of eutaxitic texture -- apparently absent in the 6-2 and 6-3 samples. The spherulitic and axiolitic textures of these samples, however, indicate that the original rock was at least partially glassy and subsequently devitrified. From the thin-sections alone, I can't say for certain if the rock represents a hypabyssal or subvolcanic intrusive, an extrusive dome, or a thick flow.

Samples 6-3 through 6-7 are mostly various textural varieties of altered, intermediate to basic composition volcanic and perhaps subvolcanic intrusive rocks (dikes?). Aphyric clinopyroxene basalt or basaltic andesite is the most common rock type; porphyritic variants are also present, and microdiorite and microdiabase account for trace to major amounts. Original mafics are largely converted to secondary phases (discussed in more detail below).

Sample 6-8 is unique in this group, consisting almost entirely of ~~medium~~ fine-crystalline biotite granodiorite with minor biotite microgranodiorite (possibly a chilled border phase or a dike rock). Basalt and andesite chips accompanying the granodiorite in this sample could represent contamination from higher in the borehole.

Altered, basic- to intermediate-composition volcanic rocks (basalts and basaltic andesites) are also the principal lithologies represented in samples 8-1 through 8-7. These rocks are virtually identical to their counterparts in the "6"-series rocks. Samples 8-3 and 8-4, in addition, also contain porphyritic quartz latite or rhyodacite. Sample 8-8 is the same rock type as 6-2 and 6-3.

The rocks of all these cuttings samples are more or less hydrothermally altered and cut by hydrothermal veinlets; discrete hydrothermal veinlet fragments are also common. Intensity of alteration appears to reflect principally original chemical composition -- the more basaltic rocks tend to be the most thoroughly altered. Principal alteration products in these basic rocks are chlorite (and chloritic mixed-layer clay), epidote and leucoxene (probably mostly microcrystalline sphene); illite (with or without phengite), potassium feldpspar, actinolite, and leucoxene are also present. Illite and phengite predominate as secondary phases in the more felsic rocks in these samples. For example, the quartz latite of 6-3 contains about 11% illite plus phengite. Most of the coarser-crystalline quartz and orthoclase observed in these felsic rocks is believed to be primary rather than hydrothermal; these phases probably crystallized as micropegmatitic intergrowths late in the cooling history of the host rock. Hydrothermal biotite is confined principally to the hornfels of sample 6-1, and may have formed with actinolite shortly after contact metamorphism.

Hydrothermal vein-forming minerals in these samples occur in numerous combinations. The principal vein-forming minerals are quartz, calcite, epidote, chlorite (with mixed-layer chlorite/smectite?) and illite or phengite. Important subordinate phases comprise potassium feldspar, actinolite, prehnite and wairakite. Vein biotite occurs only in sample 6-1. For other vein minerals occuring only locally or in trace amounts, please refer to the attached tables.

The alteration and vein assemblages detected during this study provide general information about the temperatures of the hydrothermal fluids from which these secondary phases were deposited. For example, epidote tends to form above 240°C; prehnite above 215°C; wairakite above 210°C; actinolite above 280°C; and biotite above 220oC (more commonly above 300°C) (e.g Browne, 1978, 1984; Hulen and Nielson, 1986). The mixed-layer chlorite-smectite detected in clay-fractions (especially from the "8"-series samples), if similar to that occurring in analogous rocks in Icelandic geothermal fields, could indicate formation temperatures ranging between 200°C and 270°C (Browne, 1984). Although geothermometry based only on alteration mineralogy is at best an imprecise technique, it seems certain that the rocks represented by the "6" and "8" sample series were once extensively invaded by hydrothermal fluids exceeding 200°C and locally hotter than 300°C.

Thanks very much for the opportunity to work with these particularly interesting drill cuttings. If you have further questions concerning the X-ray or petrographic signatures of these rocks, or if I can further assist you in your geothermal exploration and development work, please write or telephone me at (801)-524-3446.

Sincerely,

Jeff Hulen

Jeffrey B. Hulen

REFERENCES

Browne, P.R.L., 1978, Hydrothermal alteration in active geothermal fields: Ann. Rev. Earth Planet. Sci., 6, 229-250.

Browne, P.R.L., 1978, Lectures on geothermal geology and petrology: United Nations Univ., Geoth. Training Prog., Rept. 1984-2, 92 p.

Hulen, J.B., and Nielson, D.L., 1986, Hydrothermal alteration in the Baca geothermal system, Redondo dome, Valles caldera, New Mexico: J. Geophs. Res., 91, 1867-1886.

for: Unocal Geothermal Division, Unocal Corporation -- Daniel Carrier

16 Cuttings Samples
Bulk XRD

MINERALOGY, APPROX. WT.% [X] (or) RELATIVE ABUNDANCE [ ]

| SAMPLE NO. | QUARTZ | PLAGIOCL. | K-FELDSP. | CALCITE | CLINOPYROXN. | ACTINOLITE * | HORNBLENDE | EPIDOTE | PREHNITE | ANHYDRITE | ILMENITE &/OR MAGNETITE | HEMATITE | PYRITE | SPHENE/ LEUCOXENE | WAIRAKITE | SMECTITE | MIXED-LAYER CHLOR.-SMEC. | ILLITE AND PHENGITE ® | BIOTITE | CHLORITE | TALC | OTHER ® | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6-1 | 14 | 51 | | TR | 3 | 2 | 3 | 1 | | TR | 2 | TR | 2 | TR | | 1 | | 2 | 16 | 3 | TR | | |
| 6-2 | 42 | 30 | 22 | | | | | TR | | | TR | | | TR | | | | 4 | TR? | 2 | | | |
| 6-3 | 45 | 21 | 16 | | TR | 2 | | 1 | | TR | TR | TR | TR | 1 | | TR | | 11 | TR? | 3 | | | |
| 6-4 | 4 | 50 | 3 | 2 | 7 | 3 | | 6 | | | 5 | TR | TR | 8 | | TR | | 1 | | 11 | | | |
| 6-5 | 11 | 45 | 11 | | 3 | 2 | | 7 | | | 1 | TR | TR | 8 | | | | | | 12 | | | |
| 6-6 | 11 | 42 | 9 | | 1? | 3 | | 7 | 1 | | 1 | | 1 | 9 | | 2 | | | | 13 | | | |
| 6-7 | 19 | 38 | 10 | TR | 1? | 2 | | 5 | 2 | | 1 | | 1 | 8 | | | | TR | | 13 | | | TR. UNKNOWN, HIGH N, HIGH RELIEF, LOW BIREFRINGENCE MINERAL |
| 6-8 | 32 | 40 | 17 | TR | | 1 | | 1 | | | 1 | TR | TR | TR | | 1 | TR | 1 | 5 | 1 | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| 8-1 | 16 | 33 | 9 | 2 | 10 | 1 | | 3 | | | 2 | 5 | | 8 | | TR | TR | 5 | | 6 | | | TR. UNKNOWN, HIGH N, MOD-HIGH BIREFRINGENT SIM. TO ANHYDRITE * |
| 8-2 | 11 | 34 | 7 | TR | 13 | 2 | | 4 | | | 2 | 5 | TR | 9 | 1 | TR | TR | 2 | | 10 | | | |
| 8-3 | 17 | 35 | 11 | 1 | 10 | | | 2 | | | 1 | 4 | TR | 6 | TR? | TR | TR | 3 | | 10 | | | |
| 8-4 | 13 | 35 | 8 | 1 | 5 | | | 5 | TR | | 1 | 3 | 1 | 8 | TR? | TR | TR | 3 | | 9 | | 8 | |
| 8-5 | 20 | 30 | 5 | 1 | 5 | | | 4 | | | TR | 4 | 2 | 8 | 5 | TR | TR | 6 | | 10 | | | |
| 8-6 | 16 | 33 | 5 | 3 | 5? | 1 (or) 1 | | TR | | | 2 | 4 | TR | 9 | | TR | #SEE CHL. | 3 | | 7† | | 10 | |
| 8-7 | 7 | 43 | | 2 | 15 | | | | | | 3 | 3 | | 8 | | TR | TR | 4 | | 3 | | 12 | |
| 8-8 | 45 | 29 | 19 | | | | | | | | TR | TR | | 2 | | 1 | | 2 | | 2 | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |

* REPLACES ORIGINAL MAFICS.

® PHENGITE = BROWN TO GREEN IRON-RICH ILLITE ANALOGUE

# INCLUDES MINOR MIXED-LAYER CHLOR/SMEC.

* BLIT W/INCLINED EXTINCTION

Ⓐ AMORPHOUS, BELOW DETECTION LIMIT; MAY INCLUDE METASTABLE GLASS.

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

for: Unocal Geothermal Division, Unocal Corporation -- Daniel Carrier

16 Cuttings Samples
Clay-Fraction XRD

MINERALOGY, APPROX. WT.% [X] (or) RELATIVE ABUNDANCE [ ]

| SAMPLE NO. | SMECTITE | ILLITE & PHENG. UNDIVIDED | CHLORITE | MIXED-LAYER CHLOR/SMEC. | BIOTITE | TALC |
|---|---|---|---|---|---|---|
| 6-1 | 5 | | 8 | | *83 | 2 |
| 6-2 | TR? | 70 | 30 | | | |
| 6-3 | 2 | 93 | 5 | | | |
| 6-4 | 3 | 5 | 92 | | | |
| 6-5 | | | 100 | | | |
| 6-6 | 13 | | 87 | | | |
| 6-7 | 1 | 2 | 97 | | | |
| 6-8 | 15 | | 10 | 5 | *70 | |
| | | | | | | |
| 8-1 | 8 | 42 | 44 | 6 | | |
| 8-2 | 5 | 15 | 75 | 5 | | |
| 8-3 | 3 | 16 | 72 | 9 | | |
| 8-4 | 1 | 11 | 82 | 6 | | |
| 8-5 | 1 | 49 | 50 | TR? | | |
| 8-6 | 4 | 11 | 72 | 13 | | |
| 8-7 | 3 | *23 | 58 | 16 | | |
| 8-8 | 26 | 41 | 33 | | | |

* INCLUDES MINOR PHENGITE

* PROBABLY INCLUDES SOME GLAUCONITE

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE , EARTH SCIENCE LABORATORY

| Sample No. | Rock Types | | | | | | | | | | | | | | | NOTES, OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BASALT OR ANDESITE | Ⓐ PORPHYRITIC BASALT OR ANDESITE | Ⓑ MICRODIABASE & MICRODIORITE | Ⓒ QTZ. LATITE OR RHYODACITE | Ⓓ PORPHYRITIC QTZ. LATITE OR RHYODACITE | QUARTZ MICRODIORITE OR MICROGRANODIORITE | BIOTITE GRANODIORITE | BIOTITE MICROGRANODIORITE | HBL-BTE-QTZ-PLAG (?) GRANODIORITE | ALTERMEDIATE-? IGNIMBRITE* | VEIN FRAGMENTS | GOUGE MICROBRECCIA | | | |
| 6-1 | | | | | | | | | MM | m | m | | | | | |
| 6-2 | | | | MM* | | | | | | | TR | | | | | |
| 6-3 | | m | m | MM* | | | | | | | m | | | | | m-QTZ-SER. ROCK |
| 6-4 | M | m | M | | | | | | | | m | m | | | | TR-QTZ-CHL-ROCK |
| 6-5 | M | m | TR | m | m | | | | | | m | TR | | | | RHYODACITE (?) POST-DATES ANDESITE |
| 6-6 | MM | m | TR | TR? | | | | | | | m | | | | | CHIP OF PERLITE CEMENT |
| 6-7 | MM | m | TR | | | | | | | | m | TR | | | | |
| 6-8 | TR | | | | | | MM | m | | | TR | TR | | | | ‡ |
| | | | | | | | | | | | | | | | | |
| 8-1 | M | M | TR | TR | | m | | | | | m | TR | | | | ALSO TR LOST CIRCULATION MATERIAL |
| 8-2 | MM | m | m | m | | | | | | | m | | | | | |
| 8-3 | M | m | | m | M | | | | | | TR | m | | | | CHALCEDONY CHIP |
| 8-4 | M | m | TR | TR | m | | | | | | m | | | | | " |
| 8-5 | M | M | TR | | TR? | | | | | | m | | | | | TR-QTZ-SER. ROCK |
| 8-6 | MM | m | | | | | | | | | TR | | | | | |
| 8-7 | m | MM | | | | | | | | | TR | m | | | | MICROXLN SER.-QTZ-CHLORITE ROCK |
| 8-8 | TR | | | MM* | | | | | | | TR | TR | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | Ⓐ & Ⓑ PROBABLY JUST DIFFERENT TEXTURAL VARIETIES OF SAME ROCK TYPE. |
| | | | | | | | | | | | | | | | | Ⓒ & Ⓓ AS ABOVE. |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

| Sample No. | Veinlets | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QTZ | CAL | KF ± QTZ | EP ± Q, KF | ACT ± Q, KF, EP | CHL ± QTZ | *PHENGITE ± ILLITE CHL, QTZ | PREHNITE ± EP, QTZ, KF | WAIRAKITE ± EP, QTZ, KF | LEUCOXENE | BIOTITE | | | | |
| 6-1 | ✓ | | | ✓ | ✓ | | | | | | ✓ | | | | CPXN |
| 6-2 | ✓ | | *✓ | | | ✓ | | | | | | | | | |
| 6-3 | ✓ | | *✓ | ✓ | ✓ BIE? | ✓ | ✓ | | | | | | | | ILLITE-PYRITE |
| 6-4 | ✓ | ✓ | | ✓ | | ✓ | | | | | | | | | CHLORITE-CALCITE |
| 6-5 | ✓ | ✓ TR | | ✓ | | ✓ | | | | ✓ | | | | | CHL-EP-LEUCOXN |
| 6-6 | ✓ | ✓ TR | ✓ | ✓ | ✓ | ✓ | | ✓ | | | | | | | " " WITH " PY & KFSP; ACT-Q-CH-EP-PREHN. |
| 6-7 | ✓ | ✓ | ✓? | ✓ | | ✓ | | ✓ | | | | | | | ONE VNLT. FRAG.: EP + UNKNOWN HIGH RELIEF, ⊛ HIGH N, LOW BIREF. MINERL |
| 6-8 | · | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 8-1 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | | | | | CAL-CH-PHENGITE; Q-CAL-ILLITE-CHL |
| 8-2 | ✓ | ✓ | | ✓ | | ✓ | ✓ | | | | | | | | WAIRAKITE-CHLORITE-LEUCOXENE |
| 8-3 | ✓ | ✓ | | ✓ | | ✓ | ✓ | | | | | | | | PHENG-CHL-CALCITE |
| 8-4 | ✓ | ✓ | | ✓ | | ✓ | ✓ TR | ✓ TR | | | | | | | ⊛ CH-EP-LEUC. |
| 8-5 | ✓ | ✓ | | ✓ | | ✓ | ✓ | | ✓ | | | | | | PHENG.-CHL-CHALCEDONY; PHENG.-WAIRAKITE |
| 8-6 | ✓ | ✓ | ✓ CAL | ✓ | | ✓ | ✓ | | | | | | | | CHL-CAL-HEM; CHL-CAL-QTZ; CHL-EP-LEUCOX. |
| 8-7 | ✓ | ✓ | | | | | | | | | | | | | |
| 8-8 | ✓ | | *✓ | | | | | | | | | | | | QTZ-HEMATITE |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| * PROBABLY MICROPEGMATITIC Q-KFSP INTERGROWTH | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| ⊛ POSSIBLY PREHNITE VIEWED ⊥ TO C AXIS | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| TR = SCATTERED TRACES | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| * PHENGITE = GREEN TO BROWN (TRANSMITTED LIGHT); IRON-RICH ILLITE ANALOGUE. | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

16 Cuttings Samples: Veinlets Observed During Reconnaissance Petrography

# SEMI-QUANTITATIVE MINERALOGIC ANALYSIS BY X-RAY DIFFRACTION

## -Methods and Procedures-

**Bulk Analysis:** Representative one-gram splits of bulk samples are ground in acetone in an agate mortar to < 325 mesh (< 45 μ) then scanned at 2°2θ per minute from 2-65°2θ. Diagnostic peaks of minerals identified on resulting diffractograms are rescanned on duplicate samples. Approximate weight percentages of the minerals are determined by comparing diagnostic peak intensities with those generated by standard pure phases mixed in various known proportions.

**Clay Analysis:** Bulk samples, at least 35 grams if possible, are sonically disaggregated in deionized water, allowed to settle sufficiently to yield the desired particle size fraction (generally < 2 μ or < 5 μ), decanted and centrifuged. The resulting slurries are smeared on glass slides and X-rayed at 1°2θ per minute following air-drying (2-37°) vapor glycolation for 24 hours at 60°C (2-22°), heating to 250°C for one hour (2-15°) and heating to 550°C for one hour (2-15°). Approximate weight percentages of the layer silicates identified on diffractograms corresponding to these treatments are determined by comparison of diagnostic peak intensities with those generated by pure reference clays in appropriate mixtures.

KEY FOR XRD ANALYSES
FROM NOVEMBER 21, 1988

| WELL | SAMPLE NO. | DEPTH (FEET) |
|---|---|---|
| GMF68-8 | 8-9 | 6940-50 |
| | 8-10 | 7070-80 |
| | 8-11 | 7300-10 |
| | 8-12 | 7700-10 |
| | 8-13 | 7890-7900 |
| | 8-14 | 8060-70 |
| | 8-15 | 8160-70 |
| | 8-16 | 6593 |
| | 8-17A | 8409 |
| | 8-17B | 8413 |
| | 8-18 | FLOW LINE SAMPLE |

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

November 21, 1988

Dr. Daniel Carrier
Unocal Geothermal Division
Unocal Corporation
3576 Unocal Place
Santa Rosa CA 95406

Dear Dr. Carrier,

Attached are the revised results of XRD analysis and reconnaissance petrographic analysis of cuttings from the "8"-series group. These results, initially mailed to you in mid-October, are further interpreted in the text that follows.

Most of these samples from the "8"-series group (except for 8-10 and 8-18) are dominated by porphyritic to aphyric basalt to basaltic andesite and similar but slightly more coarsely-crystalline microdiabase. All or most appear to have contained primary pyroxene and are altered to a variety of secondary phases. Actinolite has replaced some of the pyroxene and all the primary hornblende, although traces of the latter may still be present in a few chips.

Sample 8-10 is quartz latite to quartz monzonite, essentially identical to that documented for previously analyzed samples 6-2 and 6-3. Well-developed spherulitic, granophyric and micropegmatitic textures are locally present. The lithology and devitrification textures of sample 8-10 may represent either a thick flow, or an extrusive dome, or possibly a shallow (hypabyssal or subvolcanic) intrusive.

Sample 8-18 is a rhyodacite to microgranodiorite with a sub-trachytic texture. It exhibits more flow texture than 8-10 but could also represent a dome or shallow intrusive.

Sample 8-17A may be a hydrothermal breccia; subrounded and altered clasts are present within a fine-grained matrix. The clasts are composed of fragments of porphyritic to aphyric basaltic andesite. Quartz-filled fractures crosscut the clasts within the breccia. Fragments of lineated rock lacking phenocrysts may represent minor amounts of gouge or microbreccia material in samples 8-9 to 8-15.

Like the 6-series rocks, samples 8-9 to 8-17 host a variety of secondary minerals indicative of formation at relatively high temperatures. For example, actinolite generally forms at temperatures above 280°C; biotite forms above 220 °C (more commonly above 300°C); and epidote forms above 240° C (e.g. Browne, 1978, 1984; Hulen and Nielson, 1986). Other secondary alteration phases in these samples (such as chlorite) are ambiguous as geothermometers. Some of the actinolite could be deuteric in origin, as could the chlorite and epidote, but the common occurrence of these minerals as well-developed veinlets strongly argues in favor of a fairly high-temperature hydrothermal origin. Minor amounts of discrete smectite in these samples are probably saponite; trioctahedral smectites that are more stable at higher temperatures than their dioctahedral counterparts (Eberl, Whitney and Khoury, 1978).

Traces of subordinate phases such as prehnite and serpentine identified petrographically in samples 8-11 and 8-12 also suggest a fairly high-temperature alteration of these rocks. Prehnite is believed to form between 250° C to 350° C (e.g. Bird et al., 1984).

Thank you for the opportunity to work with these interesting cuttings and for sending another core chip of sample 8-17. Diffraction of the "17"-series group is nearly completed, so those results should be forthcoming in the next few weeks. Please call me at (801) 524-3425 if you have any further questions concerning the x-ray or petrographic signatures of these rocks.

Sincerely,

Susan Lutz

Susan Lutz
Manager,
X-ray Diffraction Laboratory

References:

Browne, P.R.L., 1978, Hydrothermal alteration in active geothermal fields: Ann. Rev. Earth Planet. Sci., v. 6, p. 229-250.

Browne, P.R.L., 1984, Lectures on geothermal geology and petrology: United Nations Univ., Geoth. Training Prog., Rept. 1984-2, 92 p.

Eberl, D., Whitney, G. and Khoury, H., 1978, Hydrothermal reactivity of smectite: American Mineralogist, v. 63, p. 401-409.

Hulen, J.B., and Nielson, D.L., 1986, Hydrothermal alteration in the Baca geothermal system, Redondo dome, Valles caldera, New Mexico: J. Geophs. Res., v. 91, p. 1867-1886.

UNOCAL GEOTHERMAL - DANIEL CARRIER

10 CUTTINGS SAMPLES
8-9 TO 8-18

REVISED BULK XRD

MINERALOGY, APPROX. WT.% ☑ (or) RELATIVE ABUNDANCE ☐

| SAMPLE NO. | QUARTZ | PLAGIOCLASE | K-FELDSPAR | CALCITE | CLINOPYROXENE | ACTINOLITE | EPIDOTE | PREHNITE | ANHYDRITE | ILMENITE AND OR MAGNETITE | HEMATITE | PYRITE | SPHENE / LEUCOXENE | SMECTITE | MIXED-LAYER CHLOR-SMECT. ILITE AND/OR VERMIC. | | BIOTITE | CHLORITE | TALC | OTHER | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-9 | 7 | 45 | 5 | TR | 3 | 9≠ | 4 | | | 9 | 2 | | 9 | 1 | TR | | | 5 | | | | | TR. SERPENTINE |
| 8-10 | 41 | 34 | 17 | | TR | TR | 2 | | | 1 | TR | | 3 | 1 | | | | 1 | | | | | |
| 8-11 | 8 | 38 | 5 | 1 | 15 | 5 | 5 | | | 7 | 2 | | 6 | 1 | 1 | TR | | 5 | 1 | | | | TR. SERPENTINE |
| 8-12 | 4 | 46 | 7 | TR | 3 | 8≠ | 6 | TR | | 9 | TR | TR | 7 | 1 | | TR | | 8 | 1 | | | | |
| 8-13 | 1 | 49 | 6 | | 2 | 10 | 5 | | TR | 10 | | TR | 7 | 1 | | 1 | | 7 | | | | | |
| 8-14 | 3 | 51 | 3 | | 2 | 9≠ | 3 | | | 13 | | TR | 7 | 1 | | TR | | 8 | | | | | |
| 8-15 | 2 | 54 | 3 | TR | 2 | 10≠ | 3 | | | 10 | | TR | 6 | 1 | | TR | | 9 | | | | | |
| 8-16 | 11 | 46 | | | | 7 | 9 | | | 7 | TR | | 11 | | | | | 9 | | | | | |
| 8-17B | 1 | 41 | 3 | TR | | 19 | 5 | | | 10 | | 1 | 7 | TR | | | 11 | 6 | | | | | |
| 8-18 | 18 | 45 | 18 | | | | 7 | | | | | TR | 5 | | | | | 7 | | | | | |

≠ POSSIBLY INCLUDING VERY MINOR PRIMARY HORNBLENDE

MM = PREDOMINANT  M = MAJOR  m = MINOR  Tr = TRACE  ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

S. Lutz
11-21-88

## ROCK TYPES - REVISED

| SAMPLE NO. | BASALT OR BASALTIC ANDESITE | DIABASE Ⓐ | MICRODIABASE Ⓑ | QTZ. LATITE OR QTZ. MICROMONZONITE Ⓒ | RHYODACITE TO MICROGRANODIORITE | HYDROTHERMAL BRECCIA | GOUGE MICRODBRECCIA | VEIN FRAGMENTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-9 | MM | | m | | | | | m | m | | | | | | |
| 8-10 | TR | | | MM | | | | TR | m | | | | | | |
| 8-11 | MM | | m | | | | | m | TR | | | | | | |
| 8-12 | MM | | m | TR | | | | m | m | | | | | | |
| 8-13 | MM | | m | m | | | | m | m | | | | | | |
| 8-14 | | m | MM | M | | | | m | m | | | | | | |
| 8-15 | | | MM | M | | | | TR | TR | | | | | | |
| 8-16 | | | MM | | | | | | | | | | | | |
| 8-17A | | | | | | | MM | | | | | | | | |
| 8-17B | | | MM | | | | | | | | | | | | |
| 8-18 | | | | | MM | | | | | | | | | | |

Ⓐ, Ⓑ, & Ⓒ PROBABLY INTRUSIVE WITH Ⓐ, Ⓑ & Ⓒ PROBABLY JUST DIFFERENT TEXTURAL VARIETIES OF SAME ROCK TYPE.

QTZ LATITE - INITIALLY GLASSY: WELL-DEVELOPED SPHERULITIC, GRANOPHYRIC & MICROPEGMATITIC TEXTURES.

10 CUTTINGS SAMPLES: ROCK TYPES OBSERVED DURING RECONNAISSANCE PETROGRAPHY

| SAMPLE NO. | VEINLETS: QUARTZ | CALCITE | KF ± QTZ | EP ± Q, KF | ACT ± Q, KF, EP | CHL ± QTZ | ILLITE ± PHENGITE, QTZ | PREHNITE ± QTZ, EP, KF | WAIRAKITE ± EP, QTZ, KF | LEUCOXENE | BIOTITE ± QTZ | TALC - ACT. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-9 | °TR | TR | ✓ | ✓ | ✓ | ✓ | TR | | | | | | | | KF, EP-PHENGITE CAL-HEM |
| 8-10 | ✓ | | *✓ | ✓ | | ✓ | | | | | | | | | |
| 8-11 | ✓ | ✓ | | ✓ | ✓ | ✓ | | TR | | | | | | | PHENGITE-EP-HEM EP-PREHNITE |
| 8-12 | ✓ | TR | ✓ | ✓ | ✓ | ✓ | TR | TR | | TR | | ✓ | | | QTZ-ACT EP-LEUCOXENE |
| 8-13 | ✓ | TR | ✓ | •✓ | ✓ | ✓ | TR | | ?TR | ✓ | | | | | KF, EP-LEUCOXENE QTZ-ANH-EP |
| 8-14 | ✓ | | | ✓ | ✓ | ✓ | TR | | | TR | | | | | QTZ-ACT, PHENGITE-CHALCEDONY |
| 8-15 | ✓ | TR | | ✓ | ✓ | ✓ | | | | TR | | | | | EP-KF-ACT |
| 8-16 | | | | ✓ | ✓ | ✓ | | | | | | | | | CHL-QTZ NODULES |
| 8-17A | ✓ | | | | | | | | | | ✓ | | | | |
| 8-17B | ✓ | | | ✓ | ✓★ | ✓ | | | | | | | | | ACT-Q-KF-MAG-SPH. ± EP |
| 8-18 | | | *✓ | ✓ | | | | | | | | | | | EP-QTZ NODULES + VEIN |

* MICROPEGMATITIC Q-KF INTERGROWTH

° CHALCEDONY

★ WITH SPHENE

TR - SCATTERED TRACES

• WITH ANHYDRITE

10 CUTTINGS SAMPLES: VEINLETS OBSERVED DURING RECONNAISSANCE PETROGRAPHY

UNOCAL GEOTHERMAL - DANIEL CARRIER

8-9 TO 8-18

REVISED CLAY XRD

MINERALOGY, APPROX. WT.% ✓ (or) RELATIVE ABUNDANCE

| SAMPLE NO. | SMECTITE | ILLITE AND PHENGITE (UNDIV.) | CHLORITE | MIXED LAYER CHLOR./SMECT. | BIOTITE | TALC |
|---|---|---|---|---|---|---|
| 8-9 | 16 | | 79 | 5 | | |
| 8-10 | 10 | 76 | 14 | | | |
| 8-11 | 7 | 15 | 56 | 14 | | 8 |
| 8-12 | 4 | | 86 | | | 10 |
| 8-13 | 8 | | 92 | | | |
| 8-14 | 15 | | 85 | | | |
| 8-15 | 18 | | 82 | | | |
| 8-16 | | | 100 | | | |
| 8-17B | 3 | | 63 | | 34 | |
| 8-18 | | | 100 | | | |

MM = PREDOMINANT M = MAJOR m = MINOR Tr = TRACE ? = TENTATIVE IDENTIFICATION

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

S. Lutz
11-21-88

KEY FOR XRD ANALYSES
FROM DECEMBER 28, 1988

| WELL | SAMPLE NO. | DEPTH (FEET) |
|---|---|---|
| GMF31-17 | 17-1 | 800-10 |
| | 17-2 | 1100-10 |
| | 17-3 | 1300-10 |
| | 17-4 | 1790-1800 |
| | 17-5 | 2100-20 |
| | 17-6 | 2300-20 |
| | 17-7 | 2840-60 |
| | 17-8 | 3240-60 |
| | 17-9 | 3870-80 |
| | 17-10 | 4220-30 |
| | 17-11 | 4480-90 |
| | 17-12 | 4940-50 |
| | 17-13 | 5230-40 |
| | 17-14 | 5320-30 |
| | 17-15 | 5780-90 |
| | 17-16 | 6080-90 |
| | 17-17 | 6560-70 |
| | 17-18 | 7020-30 |
| | 17-19 | 7450-60 |
| | 17-20 | 8030-40 |
| | 17-21 | 8090-8100 |
| | 17-22 | 8250-60 |
| | 17-23 | 8787 |
| | 17-24 | 8420 |
| | 17-25 | 8422 |

UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

December 28, 1988

Dr. Daniel Carrier
Unocal Geothermal Division
Unocal Corporation
3576 Unocal Place
Santa Rosa, California 95406

Dear Dr. Carrier,

The x-ray diffraction analysis and reconnaissance petrographic analysis of cuttings from the "17"-series group are complete and appended to this letter. The results are further interpreted in the text that follows.

Rock type and mineralogy-

The "17"-series group is predominantly andesite and dacite. Compositional and textural variations of the andesite are orthopyroxene or clinopyroxene andesites, porphyritic or aphyric andesites, amygdaloidal basaltic andesites, microdiabase and meta-andesite and meta-diabase. Dacitic composition rocks include the varieties, dacite and rhyo-dacite, both porphyritic and aphyric. The lowest part of this group is granodiorite, which may or may not be genetically related to the overlying dacite.

Samples 17-1 through 17-3 exhibit relict perlitic and other devitrification textures preserved in cristobalite which has partially altered to aragonite. Most of the original mafic content of the groundmass has altered to hematite. Aragonite, smectite and traces of analcime are present as amygdule fillings. Hematite has also replaced the aragonite in some of the amygdules. Orthopyroxene phenocrysts are also common in the more phyric andesites. This interval of rocks seems to represent an originally glassy andesite flow.

Samples 17-4 through 17-6 are predominately dacite. Granophyric and spherulitic texture is well developed. Sieve-textured feldspar phenocrysts are also common in this interval. Sample 17-6 is partially silicified and partially granophyric. It could represent the originally glassy border of a shallow dacite intrusive.

Samples 17-7 through 17-16 are predominately flow-banded andesites and clinopyroxene andesites. Rare orthopyroxene phenocrysts subophitically enclose plagioclase phenocrysts in some chips. Microdiabase is common below sample 17-12 where it probably represents a slightly coarser-crystalline variant of the andesites. This interval is characterized by the alteration minerals: epidote, leucoxene and chlorite-rich chlorite-smectite. Subordinate anhydrite and wairakite are also present. The leucoxene outlines amygdules where it probably replaced primary magnetite. Quartz veins are common in samples 17-14 through 17-16.

Samples 17-17 through 17-20 are mostly porphyritic andesites and samples 17-22 and 17-25 are coarser-grained granodiorites. The granodiorites contain primary phenocrysts of hornblende and biotite. Sample 17-19 contains clasts of sandstone (now hornfels) with grains of rounded quartz that exhibit overgrowths. It may be possible that this granophyric-textured sample represents a basal flow which has picked up some grains of country rock during its deposition. Alternatively, if this dacite represents a shallow intrusive, the hornfels may be xenoliths.

Below sample 17-20 and above the granodiorite of sample 17-25, there is a zone of contact metamorphism. Granoblastic recrystallization of the original micro-diorite is locally evident in sample 17-24. The rocks is this zone are better termed meta-andesite and meta-diabase, metamorphic equivalents of the igneous rocks. Samples 17-22 and 17-25 probably represent the granodiorite intrusive responsible for the metamorphism.

Minor amounts of actinolite are present in samples 17-12 through 17-16 where it is associated with epidote and possibly crosscut by chorite-quartz veins. In other chips, the formation of epidote seems to post-date chlorite formation. The iron content of the tremolite-actinolite increases with depth, at the depth of sample 17-20 it appears pleochroic and green in plane light.

Some of the amphibole in samples 17-17 and 17-22 may be primary hornblende but most is altered to actinolite. In samples 17-18 and 17-19, the actinolite does not appear to have altered from primary hornblende and occurs in irregular veins. By the depth of sample 17-20, veins and nodules of actinolite and fine-grained veins of biotite-actinolite-talc become common. Sample 17-25 contains both primary hornblende, and primary and secondary biotite.

Most of clinopyroxene in the zone of contact metamorphism (samples 17-21, 17-23 and 17-24) is probably metamorphic in origin. It appears polygonal and equigranular, and is enclosed in potassium feldspar, triple-junction quartz, or more rarely, biotite in an incipient granoblastic texture. Although some of the clinopyroxene may be primary, it does not occur in the usual interstitial manner of igneous pyroxene.

The presence of secondary biotite in samples from the bottom of this well is also associated with thermal metamorphism of the granodiorite; the biotite occurs in fine-grained aggregates or poorly defined veinlets. However, the overlying volcanic flow rocks contain well-defined crosscutting veins of biotite-actinolite-talc that are more positively hydrothermal in origin.

Alteration zoning-

The rocks penetrated by this well clearly show well-defined mineralogic zoning which is related to increased temperatures with depth. The problem is distinguishing hydrothermal alteration from contact metamorphism.

The origin of high-level smectite, quartz and calcite, and mid-level epidote, wairakite and prehnite is almost certainly hydrothermal because these minerals occur in veinlets (and in some amygules). Some of the deeper biotite, actinolite (and rare clinopyroxene?) also occur in veins and are probably hydrothermal. However, much of the biotite and especially clinopyroxene in the zone of metamorphism is metamorphic, the rock is trying to become a hornfels.

The vein assemblages do provide information about the temperatures of the hydrothermal fluids from which some of the secondary phases were deposited. Epidote tends to form above 240°C; prehnite above 215° C; wairakite above 210 C; actinolite above 280°C; and biotite above 220°C (more commonly above 300° C) (e.g. Browne, 1978, 1984; Hulen and Nielson, 1986).

The layer silicate mineralogy of this well also reflects zoning related to temperature. Samples 17-1 through 17-4 contain 10% to 20% smectite. The air-dried basal spacing of the smectite at 14A suggests that calcium and/or magnesium are the principal interlayer cations. Because these smectites are high-level and occur in rocks that contain analcime rather than wairakite, they probably formed at low temperatures, below 160°C (Hulen and Nielson, 1986).

Samples 17-5 through 17-15 contain discrete chlorite and some mixed-layer chlorite-smectite. Some samples in this interval also contain mixed-layer illite-smectite. The amount of illite interlayers in the illite-smectite is about 70-90%. These low-expandability mixed-layer clays usually form between 175°C and 220°C (Browne, 1984) from precursor smectites, so they could have been generated during incipient to low-grade metamorphism as well as subsequent hydrothermal alteration.

Below sample 17-16, the chlorites are either discrete forms or they occur in mixed-layer chlorite-smectite. This variety of chlorite-smectite is ordered and contains about 60 to 90% smectite as indicated by a superlattice peak at about 29A (in air-dried samples). Mixed-layer chlorite-smectites are stable between 200°C and 270°C (Browne, 1984), a temperature also

permitting a low-grade metamorphic origin.

Samples 17-19 through 17-25 contain two varieties of mixed-layer chlorite-smectite, one with about 50% chlorite and the other with about 80% chlorite interlayers. The occurrence of the unordered, 50% chlorite variety with clinopyroxene, epidote and biotite, may indicate a cooling trend at depth since the higher temperature phases were formed.

Discussion-

Traces of the high-temperature alteration phases, actinolite and epidote, are present in a few fragments from the highest levels in this well (samples 17-1 and 17-2). The unusual occurrence of these high-temperature alteration phases in lower-temperature argillically-altered rocks may possibly represent lithic fragments of altered rock in dacite dikes at this level.

Veins containing intergrown calcite and quartz are common in sample 17-4. Calcite is replacing both wairakite and epidote in sample 17-7. Both these occurrences of calcite suggest that boiling (and $CO^2$ exsolution) has occurred at these levels at some time.

Below the depth of samples 17-16 and 17-17, a change in alteration occurs. Samples 17-14 and 17-16 are partially silicified. Samples 17-17 to 17-24 contain less epidote, anhydrite and leucoxene, and more actinolite, biotite, talc and ordered chlorite-smectite as alteration minerals. Perhaps the change in mineralogy reflects the change from a vapor-dominated upper zone to a water-dominated reservoir zone.

To conclude, the alteration in this well is zoned as a result of both metamorphic and hydrothermal processes. A shallow argillic zone contains abundant smectite, illite-smectite and hematite, possibly as a result of hydrothermal alteration. Cristobalite occurs as a devitrification product and aragonite, a low temperature alteration of the glass. The andesitic flow rocks in this interval may be locally cut by dacite dikes. Underneath this zone is a hydrothermal, propylitically-altered zone containing abundant epidote, chlorite and wairakite that probably formed at moderately high temperatures. Subordinate amounts of anhydrite, prehnite and illite-smectite are also present as vein-forming minerals. A silicified interval at the base of this zone may mark the transition into the lower, higher-temperature, more potassic, alteration zone. This interval is characterized by hydrothermal veins of actinolite-biotite-talc. The hydrothermal alteration in this zone seems to be superimposed on an older contact metamorphic zone characterized by biotite and clinopyroxene, which may represent a pyroxene-hornfels facies of metamorphism. The chlorite-poor chlorite-smectite in this zone may be the result of a much later, and cooler, hydrothermal system. Intrusive rocks are penetrated in the lowest part of the well. Some of the secondary biotite in the granodiorite appears to be

of metamorphic rather than hydrothermal origin. This intrusive body may represent the source of thermal metamorphism.

Thanks for the opportunity to work with these interesting cuttings. I realize that this interpretation of the origin of the clinopyroxene at the bottom of the well differs from yours. However, Jeff Hulen and I both looked at the thin-sections and we are fairly confident that most of this pyroxene is neither igneous nor hydrothermal. If you care to discuss this further or if you have any more questions about the x-ray or petrographic signatures of these rocks, please call.

Sincerely,

Susan Lutz

Susan Lutz
Manager,
X-ray Diffraction Laboratory

References

Browne, P.R.L., 1978, Hydrothermal alteration in active geothermal fields: Ann. Rev. Earth Planet. Sci., v. 6, p 229-250.

Browne, P.R.L., 1984, Lectures on geothermal geology and petrology: United Nations Univ., Geoth. Training Prog., Rept. 1984-2, 92 p.

Hulen, J.B. and Nielson, D.L., 1986, Hydrothermal alteration in the Baca geothermal system, Redondo dome, Valles caldera, New Mexico: J. Geophs. Res., v. 91, p. 1897-1886.

UNOCAL GEOTHERMAL - DANIEL CARRIER

| 17- SERIES<br>BULK XRD<br>SAMPLE NO. | MINERALOGY, APPROX. WT.% ☑ (or) RELATIVE ABUNDANCE ☐ | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CRISTOBALITE | QUARTZ | PLAGIOCLASE | K-FELDSPAR | CALCITE / ARAGONITE | CHLORITE / ACTINOLITE | ORTHOPYX / HORNBLENDE | EPIDOTE | SPHENE & LEUCOXENE UNDIV. | MAGNETITE & ILMENITE UNDIV. | HEMATITE | PYRITE | ANHYDRITE | WAIRAKITE / ANALCIME | SMECTITE | CHLORITE & CHLORITE-SMECT UNDIV. | ILLITE & ILLITE-SMECT UNDIV. | BIOTITE | TALC | AMPHIBOLES OR BEING DETECT. | OTHER | |
| 17-1 | 24 | 1 | 33 | 7 | TR / 1 | | | TR | 5 | 1 | 12 | | | TR | 12 | | | | | | | 3 | GOETHITE |
| 17-2 | | TR | 31 | 2? | 1 | 8 / TR | | TR | 11 | 4 | 4 | | | TR | 17 | | | | | | *22 | | • MOSTLY GLASS |
| 17-3 | | TR | 26 | | 3 | 1 / TR | | | 9 | 5 | 7 | | | TR | 22 | | | | | | *27 | | • MOSTLY GLASS |
| 17-4 | 25 | 6 | 15 | 26 | 1 | TR | | | 5 | 1 | 2 | 3 | | | 8 | 1 | | | | | 7 | TR | LAUMONTITE? IN QTZ VEIN |
| 17-5 | 5? | 16 | 30 | 10 | 2 / 1 | | | TR | 13 | TR | | 4 | | | 4 | 3 | | | | | 12 | | |
| 17-6 | | 22 | 26 | 15 | 2 | | | 1 | 6 | | 1 | 3 | | TR | 4 | 1 | 12 | | | | 7 | | |
| 17-7 | | 10 | 26 | 5 | 12 | | | 8 | 11 | | 2 | TR | | 7 | | 11 | 2 | | | | 6 | | |
| 17-8 | | 13 | 25 | 13 | 3 | 7 | | 6 | 7 | 5 | 3 | | | 2 | | 4 | | TR | | | 12 | | |
| 17-9 | | 10 | 23 | 10 | 1 | | | 26 | 9 | | 2 | 3 | TR | 2 | 1 | 12 | | | | | | 1 | PREHNITE |
| 17-10 | | 15 | 31 | 15 | 1 | 1 | TR | 13 | 7 | 2 | | 3 | | 4 | | 5 | 2 | | | | | 1 | PREHNITE |
| 17-11 | | 8 | 26 | 4 | | 1 | | 16 | 12 | 1 | 2 | 3 | 1 | 3 | | 11 | 1 | | | | 11 | | |
| 17-12 | | 6 | 27 | 8 | TR | 11 | 3 | 8 | 11 | 4 | 2 | 1 | TR | 1 | | 7 | | | | | 11 | | |
| 17-13 | | 12 | 28 | 9 | TR | 13 | 3 | 8 | 9 | 5 | 1 | TR | | | | 5 | | | TR | | 6 | 1 | DRILL STEEL |
| 17-14 | | 8 | 24 | 14 | | 1? | 2 | 26 | 9 | | TR | TR | TR | | | 5 | | | | | 10 | TR | DRILL STEEL |
| 17-15 | | 11 | 23 | 4 | | | 5 | 23 | 13 | 1 | | TR | | | | 7 | | | | | 13 | | |
| 17-16 | | 11 | 22 | 6 | | | 5 | 17 | 10 | 2 | TR | 1 | TR | | | 12 | | | | | 14 | | |
| 17-17 | | 4 | 35 | 5 | | | 12 | 9 | 7 | 8 | | 1 | | | | 8 | | | | | 11 | | |
| 17-18 | | 8 | 22 | 8 | | | 3 | 18 | 11 | 4 | | TR | | | | 16 | | | | | 10 | | |
| 17-19 | | 24 | 26 | 17 | | | 1 | 3 | *11 | 1 | | TR | | | | 7 | | | | | 10 | | *? VERY FINE-GRAINED |
| 17-20 | | 2 | 35 | 4 | | TR | 14 | 2 | 5 | 11 | | 1 | | | | 8 | | 3 | 1 | | 14 | | |
| 17-21 | | 1 | 38 | 3 | | 15 | 4 | 1 | 3 | 9 | | 1 | | | | 3 | 5 | 4 | 4 | | 9 | | |
| 17-22 | | 17 | 40 | 26 | | 1 | 1/4 | 1 | | 3 | | | | | | 4 | | | | | 3 | | |
| 17-23 | | 3 | 30 | 8 | | 17 | 1 | TR | 10 | 6 | | | | | | 2 | 5 | 8 | | | 10 | | |
| 17-24 | | 1 | 46 | 2 | | 19 | | | 2? | 9 | | TR | | | | | 5 | 4 | 5 | | 7 | | |
| 17-25 | | 18 | 35 | 14 | | TR | 1/3 | 2 | 2 | 7 | | TR | | | | 4 | | 13 | | | | 1 | APATITE |

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

S. Lutz
12-28-88

UNOCAL GEOTHERMAL - DANIEL CARRIER

| 17- SERIES<br>CLAY XRD<br>SAMPLE NO. | MINERALOGY, APPROX. WT.% ☑ (or) RELATIVE ABUNDANCE ☐ | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SMECTITE ★ CHLORITE & MIXED-LAYER CHL-SM UNDIV. | CHLORITE | MIXED-LAYER CHLORITE-SMECT. | MIXED-LAYER ILLITE-SMECTITE | ILLITE | BIOTITE | TALC | ACTINOLITE | % CHL IN M.L. CHL/SM | % IL IN M.L. IL/SM | BASAL SPACING(Å) OF A.D. SMECTITE | CH-SM ORDERED SUPERLATTICE | | | | | | | | | | | ★ MOSTLY CHLORITE BUT MAY CONTAIN SOME CHLORITE - RICH (80-90%) CHLORITE-SMECTITE |
| 17-1 | 100 | | | | | | | | | | | | 14.7 | | | | | | | | | | |
| 17-2 | 100 | | | | | | | | | | | | 15.0 | | | | | | | | | | |
| 17-3 | 100 | | | | | | | | | | | | 14.7 | | | | | | | | | | |
| 17-4 | 98 | 2 | | | | | | | | | | | 13.8 | | | | | | | | | | |
| 17-5 | 32 | 68 | | | | | | | | | | | | | | | | | | | | | |
| 17-6 | 23 | 2 | | | 75 | | | | | | ~70 | | 14.3 | | | | | | | | | | |
| 17-7 | TR | 78 | | | †22 | | | | | | ~90 | | | | | | | | | | | | † MAY CONTAIN SOME ILLITE OR 10Å MICA |
| 17-8 | | 100 | | | | | | | | | | | | | | | | | | | | | |
| 17-9 | 10 | 90 | | | | | | | | | | | 12.8 | | TR | | | | | | | | |
| 17-10 | 1 | 53 | | | 46 | | | | | | ~90 | | | | | | | | | | | | |
| 17-11 | | | 100 | | | | | | | | | | | | | | | | | | | | |
| 17-12 | 4 | 96 | | | | | | | | | | | | | | | | | | | | | |
| 17-13 | | | 64 | 34 | | | | 2 | TR | | | | | | TR | | | | | | | | |
| 17-14 | | 100 | | | TR | | | TR | TR | | | | | | TR | | | | | | | | |
| 17-15 | | 100 | | | | | | | ✓ | | | | | | | | | | | | | | |
| 17-16 | 1 | 99 | | | | | | | ✓ | | | | | | | | | | | | | | |
| 17-17 | | 100 | | | | | | | ✓ | | | | | | | | | | | | | | |
| 17-18 | | 98 | | 2 | | | | | TR | | | | | | | | | | | | | | |
| 17-19 | | 86 | | 14 | | | | | TR | | | | | | | | | | | | | | |
| 17-20 | | 80 | | 6 | | | †14 | TR | ✓ | | | | | | | | | | | | | | |
| 17-21 | | 22 | | 24 | | | 19 | 35 | ✓ | | | | | | | | | | | | | | |
| 17-22 | | 66 | | 34 | | | | | | | | | | | ✓ | | | | | | | | |
| 17-23 | | 29 | | 35 | | | †23 | 13 | TR | | | | | | ✓ | | | | | | | | † MAY INCLUDE SOME MIXED LAYER IL-SM |
| 17-24 | | 11 | | 21 | | | 19 | 49 | | | | | | | | | | | | | | | |
| 17-25 | | 15 | | 7 | | | 78 | | TR | | | | | | | | | | | | | | |

# SUMMARY OF X-RAY DIFFRACTION ANALYSIS

UNIVERSITY OF UTAH RESEARCH INSTITUTE, EARTH SCIENCE LABORATORY

S. Lutz
12-28-88

| 17- SERIES | | ROCK TYPES | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PLUTIC BASALT ANDESITE | BASALT ANDESITE | DACITE ANDESITE | RHYODACITE PLUTIC DACITE RHYODACITE | MICRODIABASE | METR-ANDESITE & META-BASALT | MICROGRANO-DIORITE | FINE-XLN HBL GRANODIORITE | BRECCIA (INTRUSION?) MICROBRECCIA | VEIN FRAGMENTS | GOUGE MICROBRECCIA | PLUTIC MICRO-META DACITE | |
| 17-1 | | | | M* | | | | TR | | | m[1] | | | | DACITE POST-DATES ANDESITE |
| 17-2 | | | MM | | | | | | | | TR | | | | |
| 17-3 | | Mw | Ma | m | | | | | | | TR | | | | |
| 17-4 | | m | m | M[2] | M[2] | | | | | | TR | | | | |
| 17-5 | | m | M | m | m | | | | | | | | | | |
| 17-6 | | | | MM | m | | | | | M[3] | M | | | | ONE DACITE FRAG. CONTAINS GRAPHIC MICRO-GRAPHIC |
| 17-7 | | | | MMa | | | | | | | M | | | | |
| 17-8 | | m | M | M | m | | | TR[X] | | | TR | | | | |
| 17-9 | | m | Ma | M[4] | | | | m[5] | | | M | | | | |
| 17-10 | | m | m | MM | M[4] | | | TR[5] | | TR | m | | | | |
| 17-11 | | m | M | m | | TR | | | | | M | | | | TR HIGH-T GREASE |
| 17-12 | | M | M | TR | TR | | | | | | TR | | | | OPHITIC CPXN IN ANDESITE |
| 17-13 | | | | M[2] | M[2] | M | | | | | m | | | | OPHITIC CPXN IN ANDESITE |
| 17-14 | | m | M | m | m | m | | | | | M | | | | |
| 17-15 | | m | M | m | | m | | | | | M | | | | |
| 17-16 | | | M | m? | | m | | TR | | | M | | | | |
| 17-17 | | MM | m | TR | | | | | | | m | | | | |
| 17-18 | | m | ≠M | | | m | | | | | M | m? | | | |
| 17-19 | | | TR | MM[2] | | TR | | | | | m | | | | GRANOPHYRE |
| 17-20 | | | MMa | | | | | | | | TR | | | | |
| 17-21 | | | TR? | | | | MM | | | | TR | | | | TR. QTZ-BTE. HORNFELS TR. GRAPHIC GRANITE |
| 17-22 | | | TR | | | | TR | | MM | | TR | | | | |
| 17-23 | | | | | | | M | | | | | | | | M - METADIABASE |
| 17-24 | | | | | | | | | | | | M | | | M - METADIORITE |
| 17-25 | | | | | | | | | M | | | | | | WITH BIOTITE |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| * PERLITIC, SOME W/ PINPOINT DEVITRIFICATION | | | | | | | | | | | | | | | LOCALLY DEVELOPED GRANOBLASTIC REXLN |
| (a) AMYGDALOIDAL | | | | | | | | | | | | | | | |
| (1) ALSO POSSIBLY AMYGDULE FRAGMENTS | | | | | | | | | | | | | | | |
| (2) PATCHY GRANOPHYRIC DEVITRIFICATION | | | | | | | | | | | | | | | |
| (3) COULD BE IN PART HYDROTHERMAL | | | | | | | | | | | | | | | |
| X COULD BE GRANOPHYRIC PORTION OF DACITE | | | | | | | | | | | | | | | |
| (4), (5) COULD BE JUST DIFFERENT PARTS OF SAME ROCK | | | | | | | | | | | | | | | |
| ≠ POSSIBLY VERY FINE CRYSTALLINE MICRO DIORITE | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

| 17-SERIES<br>SAMPLE NO: | VEINLETS & VEINLET FRAGS. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | QUARTZ | CALCITE | PY-QTZ | EP ± Q, KF, CHL | SERICITE | CHL ± QTZ | WAIR ± EP QTZ KF CHL | ANALCIME | SMECTITE | HEMATITE | PREHNITE ± Q EP KF CHL | KF ± QTZ | ACTINOLITE ± Q EP BTE KF EP | | |
| 17-1 | | | | ✓ | | | | ✓SM | ✓ | | | | | | HEM ± GOE |
| 17-2 | | | | | | | | | ✓ | ✓ | | | | | |
| 17-3 | | ✓? | | | | | | | ✓ | ✓ | | | | | |
| 17-4 | ✓ | | ✓ | | | | | | | | | | | | Q-CALCITE<br>Q-LEUCOXENE |
| 17-5 | ✓ | ✓ | ✓ | | | | | | | | | | | | Q-LEUCOXENE |
| 17-6 | ✓✓ | | | | | | | | | | | | | | QUARTZ |
| 17-7 | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | | | | | | | | WAI-EP-CAL-CHL<br>QTZ-KF-WAI-AB |
| 17-8 | ✓ | ✓ | | ✓ | | ✓ | ✓ | | | | | | | | WAI-EP-CHL<br>SIDERITE? |
| 17-9 | ✓ | | | ✓ | | ✓ | | | | | ✓ | ✓ | | | QTZ-EP-ANH-<br>PREHNITE |
| 17-10 | ✓ | | | ✓ | | | ✓ | | | | ✓ | | ✓TR | | |
| 17-11 | | | | ✓ | | ✓ | ✓ | | | | | | | | Q-LEUCOXENE |
| 17-12 | ✓ | | | ✓ | | ✓ | | | | | ✓ | | | | EP-ANHYDRITE |
| 17-13 | ✓ | | | ✓ | | | | | | | | | | | Q-HEMATITE |
| 17-14 | ✓ | | | ✓ | ✓? | | | | | | | | | | ANHYDRITE |
| 17-15 | ✓ | | | ✓ | | ✓ | | | | | | ✓ | ✓ | | LEUCOXENE |
| 17-16 | ✓ | | | ✓ | | ✓ | | | | | | | | | |
| 17-17 | ✓ | | | ✓ | | ✓ | | | | | | ✓ | | | |
| 17-18 | ✓ | | | ✓ | | | | | | | | ✓ | ✓ | | |
| 17-19 | ✓ | | | ✓ | | | | | | | | ✓ | | | |
| 17-20 | ✓ | | | ✓ | | ✓ | | | | | | ✓ | ✓✓ | | QTZ-ACT-BTE<br>PHENGITE? |
| 17-21 | ✓ | | | | | | | | | | | ✓ | ✓✓ | | KF-QTZ<br>BTE-QTZ |
| 17-22 | | | | ✓ | | | | | | | | | | | |
| 17-23 | ✓ | ✓ | | ✓ | | | | | | | | | ✓ | | CLINOPYROXENE<br>BTE ± QTZ |
| 17-24 | | | | | | | | | | | | | | | |
| 17-25 | | | | | | | | | | | | | | | |

# APPENDIX 2

## MAJOR OXIDE ANALYSES

Bondar-Clegg, Inc.
12980 West Cedar Dr.
Lakewood, Colorado
U.S.A. 80228
Phone: (303) 989-1404
Telex: 45-693

BONDAR-CLEGG

Geochemical
Lab Report

UNION GEOTHERMAL
MR. RICHARD GUNDERSON
UNION GEOTHERMAL
P.O. BOX 6854
SANTA ROSA, CA 95406

ALEX SCHRIENER
JAN 28 1986

Bondar-Clegg, Inc.
12980 West Cedar Dr.
Lakewood, Colorado
U.S.A. 80228
Phone: (303) 989-1404
Telex: 45-693

BONDAR-CLEGG

Geochemical Lab Report

REPORT: 155-0321 ( COMPLETE )

REFERENCE INFO:

CLIENT: UNION GEOTHERMAL
PROJECT: RG-01

SUBMITTED BY: GUNDERSON
DATE PRINTED: 3-OCT-85

| ORDER | ELEMENT | NUMBER OF ANALYSES | LOWER DETECTION LIMIT | EXTRACTION | METHOD |
|---|---|---|---|---|---|
| 1 | SiO2 Silica (SiO2) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 2 | Al2O3 Alumina (Al2O3) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 3 | Fe2O3* Total Iron (Fe2O3*) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 4 | MnO Manganese (MnO) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 5 | MgO Magnesium (MgO) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 6 | CaO Calcium (CaO) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 7 | Na2O Sodium (Na2O) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 8 | K2O Potassium (K2O) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 9 | TiO2 Titanium (TiO2) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 10 | P2O5 Phosphorous (P2O5) | 49 | 0.05 PCT | MULTI ACID - MIBK | D.C. Plasma |
| 11 | LOI Loss on Ignition | 49 | 0.05 PCT | MULTI ACID - MIBK | Gravimetric |

| SAMPLE TYPES | NUMBER |
|---|---|
| R ROCKS | 49 |

| SIZE FRACTIONS | NUMBER |
|---|---|
| 6 -100 | 49 |

| SAMPLE PREPARATIONS | NUMBER |
|---|---|
| PREP AS PER 1ST REPORT IN SERIES | 49 |

REMARKS: CE EUL HO LA LU ND SCL SM TB THL TM YB
TO FOLLOW

REPORT COPIES TO: MR. RICHARD GUNDERSON

INVOICE TO: MR. RICHARD GUNDERSON

ALEX SCHRIENER
JAN 28 1986

Bondar-Clegg, Inc.
12980 West Cedar Dr.
Lakewood, Colorado
U.S.A. 80228
Phone: (303) 989-1404
Telex: 45-693

BONDAR-CLEGG

Geo La

ALEX SCHRIENER

JAN 28 1986

REPORT: 155-0321 PROJECT: RG-01 PAGE 1

| SAMPLE NUMBER | ELEMENT UNITS | SiO2 PCT | Al2O3 PCT | Fe2O3* PCT | MnO PCT | MgO PCT | CaO PCT | Na2O PCT | K2O PCT | TiO2 PCT | P2O5 PCT | LOI PCT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R6 14-23-816 | | 66.50 | 14.50 | 3.40 | 0.07 | 0.80 | 2.50 | 4.50 | 4.30 | 0.65 | 0.14 | 0.50 |
| R6 14-23-1462 | | 54.00 | 15.00 | 9.10 | 0.14 | 3.90 | 8.00 | 4.00 | 1.60 | 1.50 | 0.30 | 2.10 |
| R6 14-23-1903 | | 70.00 | 13.00 | 1.70 | 0.04 | 0.60 | 1.50 | 4.00 | 4.50 | 0.25 | 0.04 | 2.30 |
| R6 17A-6-200 | | 57.00 | 15.50 | 8.20 | 0.13 | 3.20 | 6.80 | 4.30 | 1.60 | 1.35 | 0.30 | 0.95 |
| R6 17A-6-2100 | | 56.00 | 15.00 | 9.20 | 0.16 | 2.80 | 6.80 | 4.40 | 1.80 | 1.70 | 0.50 | 1.50 |
| R6 17A-6-4750 | | 52.50 | 16.00 | 8.90 | 0.14 | 4.50 | 9.40 | 4.00 | 0.70 | 1.30 | 0.25 | 1.40 |
| R6 17A-6-5820 | | 74.50 | 13.00 | 1.00 | 0.01 | 0.50 | 1.00 | 4.00 | 4.60 | 0.10 | 0.06 | 0.60 |
| R6 17A-6-6900 | | 56.50 | 17.00 | 7.10 | 0.07 | 3.50 | 8.10 | 4.00 | 1.50 | 1.05 | 0.25 | 0.95 |
| R6 17A-6-7710 | | 66.00 | 15.00 | 3.60 | 0.06 | 1.80 | 4.20 | 4.20 | 3.80 | 0.70 | 0.17 | 0.50 |
| R6 17A-6-7750 | | 70.50 | 14.00 | 2.90 | 0.05 | 0.80 | 2.50 | 4.50 | 3.80 | 0.30 | 0.09 | 0.35 |
| R6 17A-6-8400 | | 64.00 | 15.50 | 5.00 | 0.09 | 1.60 | 4.30 | 4.80 | 2.80 | 0.90 | 0.35 | 0.65 |
| R6 17A-6-9000 | | 66.00 | 15.50 | 4.40 | 0.08 | 1.30 | 3.50 | 4.50 | 3.10 | 0.85 | 0.20 | 0.45 |
| R6 18-34-1049 | | 68.50 | 14.00 | 3.00 | 0.07 | 0.80 | 2.60 | 4.00 | 3.50 | 0.65 | 0.13 | 0.95 |
| R6 18-34-1289 | | 74.50 | 13.00 | 1.70 | 0.04 | 0.40 | 1.30 | 4.00 | 4.00 | 0.25 | 0.09 | 0.25 |
| R6 18-34-2507 | | 65.00 | 15.50 | 4.20 | 0.08 | 1.20 | 3.50 | 4.30 | 3.80 | 0.80 | 0.25 | 0.60 |
| 18-34-3498 | | 53.50 | 17.00 | 7.50 | 0.14 | 5.00 | 9.50 | 3.50 | 0.90 | 1.10 | 0.20 | 0.65 |
| R6 27-27-1266 | | 56.00 | 17.00 | 6.90 | 0.12 | 4.50 | 8.30 | 3.50 | 1.40 | 1.05 | 0.25 | 0.30 |
| R6 27-27-2145 | | 53.50 | 17.00 | 7.00 | 0.12 | 5.40 | 9.20 | 3.50 | 1.10 | 0.95 | 0.25 | 0.25 |
| R6 27-27-2785 | | 51.00 | 16.50 | 8.50 | 0.15 | 5.40 | 9.50 | 3.80 | 1.00 | 1.45 | 0.40 | 0.85 |
| R6 28-32-485 | | 67.50 | 14.50 | 3.10 | 0.10 | 1.10 | 2.80 | 4.00 | 3.30 | 0.50 | 0.10 | 2.35 |
| R6 28-32-1061 | | 69.00 | 14.50 | 3.20 | 0.06 | 0.90 | 2.50 | 4.50 | 3.80 | 0.55 | 0.12 | 0.40 |
| R6 28-32-1497 | | 71.50 | 14.00 | 2.40 | 0.04 | 0.70 | 2.00 | 4.00 | 4.10 | 0.40 | 0.09 | 0.30 |
| R6 28-32-2258 | | 72.00 | 12.50 | 2.50 | 0.05 | 0.50 | 1.50 | 4.00 | 3.30 | 0.50 | 0.11 | 1.70 |
| R6 28-32-2514 | | 67.50 | 13.00 | 2.20 | 0.05 | 0.40 | 1.50 | 3.50 | 4.10 | 0.45 | 0.11 | 5.70 |
| R6 28-32-3187 | | 72.00 | 13.00 | 1.00 | 0.04 | 0.20 | 1.20 | 3.50 | 3.90 | 0.05 | 0.01 | 2.45 |
| R6 28-32-3968 | | 58.00 | 13.00 | 6.50 | 0.25 | 1.70 | 4.50 | 4.00 | 1.50 | 1.35 | 0.65 | 7.30 |
| R6 29-1-467 | | 70.00 | 14.00 | 2.50 | 0.06 | 0.60 | 2.30 | 4.50 | 3.40 | 0.55 | 0.15 | 0.30 |
| R6 29-1-873 | | 60.00 | 15.00 | 5.80 | 0.15 | 3.00 | 6.50 | 3.80 | 2.00 | 0.95 | 0.20 | 0.30 |
| R6 29-1-2375 | | 70.00 | 12.00 | 1.40 | 0.03 | 0.20 | 1.20 | 3.80 | 4.50 | 0.25 | 0.04 | 4.25 |
| R6 29-1-3088 | | 55.50 | 15.50 | 7.50 | 0.13 | 3.80 | 8.00 | 3.70 | 1.20 | 1.30 | 0.25 | 1.30 |
| R6 45-36-1419 | | 58.50 | 15.00 | 7.50 | 0.16 | 2.50 | 5.00 | 4.50 | 1.40 | 1.50 | 0.30 | 1.85 |
| R6 45-36-2379 | | 48.00 | 15.50 | 9.00 | 0.17 | 5.50 | 10.00 | 3.30 | 0.50 | 1.70 | 0.40 | 3.85 |
| R6 45-36-2842 | | 46.50 | 18.00 | 9.20 | 0.18 | 4.00 | 7.00 | 4.50 | 1.20 | 1.50 | 0.35 | 4.85 |
| R6 57-13-781 | | 71.00 | 13.50 | 2.50 | 0.05 | 0.60 | 1.80 | 4.30 | 4.20 | 0.45 | 0.04 | 0.25 |
| R6 56-13-1423 | | 70.50 | 12.50 | 1.30 | 0.03 | 0.30 | 1.20 | 4.00 | 4.50 | 0.15 | 0.03 | 4.80 |
| R6 57-13-1637 | | 71.50 | 12.50 | 1.30 | 0.03 | 0.30 | 1.20 | 4.00 | 4.30 | 0.20 | 0.04 | 3.80 |
| 7-13-2929 | | 54.50 | 17.00 | 6.10 | 0.12 | 4.50 | 8.50 | 4.00 | 1.00 | 0.90 | 0.20 | 1.45 |
| 62-21-1700 | | 49.50 | 16.50 | 7.00 | 0.14 | 6.70 | 10.00 | 3.00 | 0.40 | 0.80 | 0.10 | 4.45 |
| R6 65-26-625 | | 68.50 | 14.00 | 2.90 | 0.06 | 1.00 | 2.80 | 4.50 | 4.10 | 0.55 | 0.11 | 0.25 |
| R6 65-26-938 | | 62.50 | 14.50 | 5.20 | 0.11 | 1.90 | 4.50 | 5.00 | 2.70 | 1.20 | 0.25 | 0.35 |

Bondar-Clegg, Inc.
12986 West Cedar Dr.
Lakewood, Colorado
U.S.A. 80228
Phone: (303) 989-1404
Telex: 45-693

BONDAR-CLEGG

Geochemical Lab Report

ALEX SCHRIENER

JAN 28 1986

REPORT: 155-0321 PROJECT: RG-01 PAGE 2

| SAMPLE NUMBER | ELEMENT UNITS | SiO2 PCT | Al2O3 PCT | Fe2O3* PCT | MnO PCT | MgO PCT | CaO PCT | Na2O PCT | K2O PCT | TiO2 PCT | P2O5 PCT | LOI PCT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R6 65-26-1784 | | 71.00 | 13.00 | 1.50 | 0.03 | 0.20 | 1.00 | 3.50 | 5.00 | 0.15 | 0.02 | 3.95 |
| R6 68-16-504 | | 71.50 | 13.50 | 2.20 | 0.04 | 0.50 | 1.80 | 4.00 | 4.90 | 0.35 | 0.10 | 0.20 |
| R6 68-16-1338 | | 72.00 | 12.50 | 1.80 | 0.04 | 0.35 | 1.50 | 4.50 | 4.50 | 0.30 | 0.01 | 1.50 |
| R6 68-16-1857 | | 73.50 | 12.50 | 1.40 | 0.03 | 0.20 | 1.10 | 4.00 | 4.50 | 0.15 | 0.05 | 1.45 |
| R6 68-16-2227 | | 57.00 | 16.00 | 5.80 | 0.10 | 3.90 | 7.80 | 3.80 | 1.70 | 0.80 | 0.20 | 1.15 |
| R6 68-16-2936 | | 72.50 | 13.50 | 1.50 | 0.04 | 0.20 | 1.10 | 4.50 | 4.80 | 0.08 | <0.01 | 0.35 |
| R6 86-23-1085 | | 55.50 | 18.50 | 6.00 | 0.10 | 4.10 | 8.50 | 3.50 | 1.00 | 0.65 | 0.15 | 1.10 |
| R6 86-23-2103 | | 55.00 | 17.00 | 7.50 | 0.12 | 3.90 | 8.20 | 3.50 | 1.80 | 1.00 | 0.45 | 0.75 |
| R6 86-23-3197 | | 51.50 | 15.50 | 10.00 | 0.16 | 4.20 | 8.00 | 4.00 | 1.80 | 1.40 | 0.70 | 1.90 |

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS,
NEVADA, U.S.A. 89431
PHONE (702) 356-5395

T NION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406

DAN R

OCT 2 0 1988

*** INVOICE NUMBER I8824092 ***

BILLING INFORMATION

Date : 29-SEP-88
Project :
P.O. # : 480926
Account : CDN

Billing : For analysis performed on
Certificate A8824092

Terms : Net payment in 30 Days
1.5% per month (18% per annum)
charged on overdue accounts.

Please remit payments to:

CHEMEX LABS, INC.
994 West Glendale Ave.,
Suite 7, Sparks, Nevada,
U.S.A. 89431

| CHEMEX CODE | ANALYSIS DESCRIPTION | SAMPLES ANALYZED | UNIT PRICE | AMOUNT |
|---|---|---|---|---|
| G12 | - A-12 W.R.A. | 16 | 16.00 | 256.00 |
| Sample preparation and other charges : | | | | |
| 217 | - Geochem - RING ONLY | 16 | 2.50 | 40.00 |
| 232 | - Total ICP digestion | 16 | 0.00 | 0.00 |
| | | | Total Cost $ | 296.00 |
| | | | TOTAL PAYABLE (U.S.) $ | 296.00 |

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS,
NEVADA, U.S.A. 89431
PHONE (702) 356-5395

To: UNION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406

A8824092

Comments: ATTN: DANIEL CARRIER

# CERTIFICATE A8824092

UNION OIL COMPANY OF CALIFORNIA
PROJECT :
# : 480926

Samples submitted to our lab in Sparks, NV.
This report was printed on 29-SEP-88.

## SAMPLE PREPARATION

| CHEMEX CODE | NUMBER SAMPLES | DESCRIPTION |
|---|---|---|
| 217 | 16 | Geochem:Ring only.no crush/split |
| 232 | 16 | Total ICP digestion |

* NOTE 1:

Code 1000 is used for repeat gold analyses It shows typical sample variability due to coarse gold effects. Each value is correct for its particular subsample.

## ANALYTICAL PROCEDURES

| CHEMEX CODE | NUMBER SAMPLES | DESCRIPTION | METHOD | DETECTION LIMIT | UPPER LIMIT |
|---|---|---|---|---|---|
| 592 | 16 | SiO2 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 594 | 16 | Al2O3 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 586 | 16 | Fe2O3(total) %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 593 | 16 | MgO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 588 | 16 | CaO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 599 | 16 | Na2O %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 821 | 16 | K2O %: Whole rock | ICP-AES | 0.01 | 99.0 |
| 595 | 16 | TiO2 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 597 | 16 | P2O5 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 596 | 16 | MnO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 542 | 16 | BaO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 475 | 16 | L.O.I. %: Loss on ignition | FURNACE | 0.01 | 99.00 |
| 540 | 16 | Total % | CALCULATION | 0.01 | N/A |

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS, NEVADA, U.S.A. 89431
PHONE (702) 356-5395

To ION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406
Project :
Comments: ATTN: DANIEL CARRIER

Page No
Tot. Pages: 1
Date :29-SEP-88
Invoice # :I-8824092
P.O. # :480926

# CERTIFICATE OF ANALYSIS A8824092

| SAMPLE DESCRIPTION | PREP CODE | | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | BaO % | LOI % | TOTAL % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31-3180 | 217 | 232 | 55.77 | 17.60 | 7.81 | 4.02 | 7.89 | 3.95 | 1.10 | 0.93 | 0.22 | 0.12 | 0.04 | 1.84 | 101.30 |
| 31-3660 | 217 | 232 | 55.19 | 18.05 | 7.97 | 3.72 | 8.19 | 3.60 | 0.78 | 1.00 | 0.29 | 0.12 | 0.05 | 1.65 | 100.60 |
| 31-4300 | 217 | 232 | 64.16 | 15.76 | 4.16 | 1.49 | 3.79 | 4.65 | 2.26 | 0.60 | 0.22 | 0.09 | 0.09 | 1.66 | 98.94 |
| 31-4510 | 217 | 232 | 51.56 | 17.50 | 9.77 | 5.21 | 9.15 | 3.30 | 0.67 | 1.14 | 0.24 | 0.14 | 0.04 | 1.83 | 100.55 |
| 31-4600 | 217 | 232 | 50.37 | 17.91 | 9.10 | 4.94 | 9.31 | 3.66 | 0.38 | 1.18 | 0.28 | 0.14 | 0.04 | 2.31 | 99.63 |
| 31-4780 | 217 | 232 | 50.38 | 17.11 | 9.66 | 5.56 | 9.14 | 3.78 | 0.53 | 1.42 | 0.35 | 0.15 | 0.03 | 1.91 | 100.05 |
| 31-4960 | 217 | 232 | 49.32 | 17.98 | 10.15 | 3.27 | 10.13 | 3.48 | 0.12 | 1.13 | 0.24 | 0.15 | 0.03 | 3.02 | 99.03 |
| 31-5020 | 217 | 232 | 54.38 | 18.64 | 7.90 | 3.65 | 7.12 | 3.54 | 0.73 | 1.05 | 0.29 | 0.12 | 0.05 | 2.99 | 100.45 |
| 31-5160 | 217 | 232 | 72.22 | 14.54 | 2.31 | 0.45 | 1.24 | 4.76 | 4.44 | 0.37 | 0.11 | 0.02 | 0.09 | 0.80 | 101.35 |
| 31-5320 | 217 | 232 | 55.61 | 17.03 | 6.61 | 3.88 | 8.60 | 3.04 | 1.04 | 0.52 | 0.14 | 0.10 | 0.03 | 2.48 | 99.09 |
| 31-6280 | 217 | 232 | 51.07 | 18.59 | 8.45 | 5.64 | 9.09 | 3.62 | 0.56 | 0.90 | 0.25 | 0.13 | 0.03 | 1.72 | 100.05 |
| 31-6540 | 217 | 232 | 50.51 | 19.16 | 8.72 | 4.34 | 9.45 | 3.52 | 0.20 | 1.03 | 0.22 | 0.13 | 0.03 | 1.64 | 98.96 |
| 31-6940 | 217 | 232 | 49.31 | 18.00 | 9.38 | 6.10 | 9.04 | 3.40 | 0.46 | 1.14 | 0.29 | 0.16 | 0.03 | 1.50 | 98.82 |
| 31-7240 | 217 | 232 | 48.94 | 19.83 | 8.58 | 5.29 | 9.87 | 3.24 | 0.07 | 0.94 | 0.17 | 0.14 | 0.02 | 1.46 | 98.56 |
| 31-7600 | 217 | 232 | 49.49 | 17.87 | 9.17 | 6.17 | 8.82 | 3.42 | < 0.01 | 1.08 | 0.24 | 0.15 | 0.06 | 1.43 | 97.92 |
| 31-8090 | 217 | 232 | 51.10 | 18.29 | 9.33 | 5.58 | 8.66 | 3.89 | 0.19 | 1.06 | 0.32 | 0.14 | 0.04 | 0.45 | 99.06 |

CERTIFICATION : B. Caughlin

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE.; SUITE 7, SPARKS, NEVADA, U.S.A. 89431
PHONE (702) 356-5395

To ON OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406
Project :
Comments: ATTN: DANIEL CARRIER

Page No.
Tot. Pages: 1
Date :29-SEP-88
Invoice # :I-8824092
P.O. # :480926

# CERTIFICATE OF ANALYSIS A8824092

| SAMPLE DESCRIPTION | PREP CODE | | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | BaO % | LOI % | TOTAL % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31-3180 | 217 | 232 | 55.77 | 17.60 | 7.81 | 4.02 | 7.89 | 3.95 | 1.10 | 0.93 | 0.22 | 0.12 | 0.04 | 1.84 | 101.30 |
| 31-3660 | 217 | 232 | 55.19 | 18.05 | 7.97 | 3.72 | 8.19 | 3.60 | 0.78 | 1.00 | 0.29 | 0.12 | 0.05 | 1.65 | 100.60 |
| 31-4300 | 217 | 232 | 64.16 | 15.76 | 4.16 | 1.49 | 3.79 | 4.65 | 2.26 | 0.60 | 0.22 | 0.09 | 0.09 | 1.66 | 98.94 |
| 31-4510 | 217 | 232 | 51.56 | 17.50 | 9.77 | 5.21 | 9.15 | 3.30 | 0.67 | 1.14 | 0.24 | 0.14 | 0.04 | 1.83 | 100.55 |
| 31-4600 | 217 | 232 | 50.37 | 17.91 | 9.10 | 4.94 | 9.31 | 3.66 | 0.38 | 1.18 | 0.28 | 0.14 | 0.04 | 2.31 | 99.63 |
| 31-4780 | 217 | 232 | 50.38 | 17.11 | 9.66 | 5.56 | 9.14 | 3.78 | 0.53 | 1.42 | 0.35 | 0.15 | 0.03 | 1.91 | 100.05 |
| 31-4960 | 217 | 232 | 49.32 | 17.98 | 10.15 | 3.27 | 10.13 | 3.48 | 0.12 | 1.13 | 0.24 | 0.15 | 0.03 | 3.02 | 99.03 |
| 31-5020 | 217 | 232 | 54.38 | 18.64 | 7.90 | 3.65 | 7.12 | 3.54 | 0.73 | 1.05 | 0.29 | 0.12 | 0.05 | 2.99 | 100.45 |
| 31-5160 | 217 | 232 | 72.22 | 14.54 | 2.31 | 0.45 | 1.24 | 4.76 | 4.44 | 0.37 | 0.11 | 0.02 | 0.09 | 0.80 | 101.35 |
| 31-5320 | 217 | 232 | 55.61 | 17.03 | 6.61 | 3.88 | 8.60 | 3.04 | 1.04 | 0.52 | 0.14 | 0.10 | 0.03 | 2.48 | 99.09 |
| 31-6280 | 217 | 232 | 51.07 | 18.59 | 8.45 | 5.64 | 9.09 | 3.62 | 0.56 | 0.90 | 0.25 | 0.13 | 0.03 | 1.72 | 100.05 |
| 31-6540 | 217 | 232 | 50.51 | 19.16 | 8.72 | 4.34 | 9.45 | 3.52 | 0.20 | 1.03 | 0.22 | 0.13 | 0.03 | 1.64 | 98.96 |
| 31-6940 | 217 | 232 | 49.31 | 18.00 | 9.38 | 6.10 | 9.04 | 3.40 | 0.46 | 1.14 | 0.29 | 0.16 | 0.03 | 1.50 | 98.82 |
| 31-7240 | 217 | 232 | 48.94 | 19.83 | 8.58 | 5.29 | 9.87 | 3.24 | 0.07 | 0.94 | 0.17 | 0.14 | 0.02 | 1.46 | 98.56 |
| 31-7600 | 217 | 232 | 49.49 | 17.87 | 9.17 | 6.17 | 8.82 | 3.42 | < 0.01 | 1.08 | 0.24 | 0.15 | 0.06 | 1.43 | 97.92 |
| 31-8090 | 217 | 232 | 51.10 | 18.29 | 9.33 | 5.58 | 8.66 | 3.89 | 0.19 | 1.06 | 0.32 | 0.14 | 0.04 | 0.45 | 99.06 |

CERTIFICATION : B. Caughlin

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS,
NEVADA, U.S.A. 89431
PHONE (702) 356-5395

To: UNION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406

A8824092

Comments: ATTN: DANIEL CARRIER

# CERTIFICATE A8824092

UNION OIL COMPANY OF CALIFORNIA
PROJECT :
P O # : 480926

ples submitted to our lab in Sparks, NV.
This report was printed on 29-SEP-88.

## SAMPLE PREPARATION

| CHEMEX CODE | NUMBER SAMPLES | DESCRIPTION |
|---|---|---|
| 217 | 16 | Geochem:Ring only,no crush/split |
| 232 | 16 | Total ICP digestion |

* NOTE 1:

Code 1000 is used for repeat gold analyses It shows typical sample variability due to coarse gold effects. Each value is correct for its particular subsample.

## ANALYTICAL PROCEDURES

| CHEMEX CODE | NUMBER SAMPLES | DESCRIPTION | METHOD | DETECTION LIMIT | UPPER LIMIT |
|---|---|---|---|---|---|
| 592 | 16 | SiO2 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 594 | 16 | Al2O3 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 586 | 16 | Fe2O3(total) %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 593 | 16 | MgO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 588 | 16 | CaO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 599 | 16 | Na2O %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 821 | 16 | K2O %: Whole rock | ICP-AES | 0.01 | 99.0 |
| 595 | 16 | TiO2 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 597 | 16 | P2O5 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 596 | 16 | MnO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 542 | 16 | BaO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 475 | 16 | L.O.I. %: Loss on ignition | FURNACE | 0.01 | 99.00 |
| 540 | 16 | Total % | CALCULATION | 0.01 | N/A |

# Chemex Labs Inc.

Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS, NEVADA, U.S.A. 89431
PHONE (702) 356-5395


To: UNION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406

## * INVOICE NUMBER I8829139 *

### BILLING INFORMATION

Date : 4-JAN-89
Project :
P.O. # : 480926
Account : CDN

Comments: AFE #480926

Billing : For analysis performed on Certificate A8829139

Terms : Net payment in 30 Days
1.5% per month (18% per annum) charged on overdue accounts.

Please remit payments to:

CHEMEX LABS, INC.
994 West Glendale Ave.,
Suite 7, Sparks, Nevada,
U.S.A. 89431

| CHEMEX CODE | ANALYSIS DESCRIPTION | SAMPLES ANALYZED | UNIT PRICE | AMOUNT |
|---|---|---|---|---|
| G12 | A-12 W.R.A. | 33 | 16.00 | 528.00 |
| Sample preparation and other charges : | | | | |
| 205 | Rock Geochem - RING | 1 | 3.00 | 3.00 |
| 232 | Total ICP digestion | 1 | 0.00 | 0.00 |
| 217 | Geochem - RING ONLY | 24 | 2.50 | 60.00 |
| 232 | Total ICP digestion | 24 | 0.00 | 0.00 |
| 218 | Pulverize only -no crush | 8 | 3.25 | 26.00 |
| 232 | Total ICP digestion | 8 | 0.00 | 0.00 |
| | | | Total Cost $ | 617.00 |
| | | | TOTAL PAYABLE (U.S.) $ | 617.00 |

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS,
NEVADA, U.S.A. 89431
PHONE (702) 356-5395

To: UNION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406

A8829139

Comments: ATTN: DANIEL L. CARRIER

# CERTIFICATE A8829139

UNION OIL COMPANY OF CALIFORNIA
PROJECT :
P.O.# : 480926

Samples submitted to our lab in Sparks, NV.
This report was printed on 4-JAN-89.

## SAMPLE PREPARATION

| CHEMEX CODE | NUMBER SAMPLES | DESCRIPTION |
|---|---|---|
| 205 | 1 | Rock Geochem: Crush.split.ring |
| 217 | 24 | Geochem:Ring only.no crush/split |
| 218 | 8 | Pulverize only - no crush/split |
| 232 | 33 | Total ICP digestion |

* NOTE 1:

Code 1000 is used for repeat gold analyses It shows typical sample variability due to coarse gold effects. Each value is correct for its particular subsample.

## ANALYTICAL PROCEDURES

| CHEMEX CODE | NUMBER SAMPLES | DESCRIPTION | METHOD | DETECTION LIMIT | UPPER LIMIT |
|---|---|---|---|---|---|
| 592 | 33 | SiO2 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 594 | 33 | Al2O3 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 586 | 33 | Fe2O3(total) %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 593 | 33 | MgO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 588 | 33 | CaO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 599 | 33 | Na2O %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 821 | 33 | K2O %: Whole rock | ICP-AES | 0.01 | 99.0 |
| 595 | 33 | TiO2 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 597 | 33 | P2O5 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 596 | 33 | MnO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 542 | 33 | BaO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 475 | 33 | L.O.I. %: Loss on ignition | FURNACE | 0.01 | 99.00 |
| 540 | 33 | Total % | CALCULATION | 0.01 | N/A |

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS, NEVADA, U.S.A. 89431
PHONE (702) 356-5395

To .ION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406
Project :
Comments: ATTN: DANIEL L. CARRIER


Date : 4-JAN-89
Invoice # : I-8829139
P.O. # : 480926

# CERTIFICATE OF ANALYSIS A8829139

| SAMPLE DESCRIPTION | PREP CODE | | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | BaO % | LOI % | TOTAL % | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6-1090-00 | 217 | 232 | 65.17 | 15.17 | 5.37 | 2.03 | 3.96 | 4.02 | 3.63 | 0.68 | 0.19 | 0.08 | 0.06 | < 0.01 | 100.35 | |
| 6-2020-30 | 217 | 232 | 65.91 | 15.31 | 5.09 | 1.28 | 3.20 | 4.88 | 3.31 | 0.77 | 0.28 | 0.08 | 0.07 | 0.86 | 101.05 | |
| 6-4630-40 | 217 | 232 | 52.79 | 15.13 | 9.85 | 2.81 | 6.58 | 4.24 | 2.03 | 1.56 | 0.48 | 0.17 | 0.06 | 2.73 | 98.44 | |
| 6-5010-20 | 218 | 232 | 58.70 | 16.59 | 6.51 | 2.36 | 6.73 | 4.35 | 1.74 | 0.99 | 0.31 | 0.13 | 0.05 | 1.84 | 100.30 | |
| 6-5220-30 | 218 | 232 | 54.33 | 17.77 | 7.24 | 3.51 | 7.65 | 3.95 | 1.90 | 0.96 | 0.25 | 0.12 | 0.04 | 1.72 | 99.45 | |
| 6-5560-70 | 218 | 232 | 61.59 | 16.73 | 5.40 | 1.74 | 4.69 | 5.54 | 2.17 | 0.82 | 0.22 | 0.12 | 0.06 | 1.26 | 100.35 | |
| 6-6110-20 | 218 | 232 | 52.49 | 16.52 | 9.88 | 3.66 | 7.40 | 4.46 | 0.81 | 1.43 | 0.35 | 0.16 | 0.04 | 1.33 | 98.54 | |
| 6-6360-70 | 218 | 232 | 50.51 | 16.48 | 10.12 | 5.60 | 9.18 | 3.45 | 0.89 | 1.47 | 0.43 | 0.17 | 0.03 | 1.28 | 99.62 | |
| 6-6650-60 | 218 | 232 | 76.18 | 12.79 | 1.38 | 0.16 | 0.56 | 4.02 | 4.44 | 0.09 | 0.06 | 0.02 | 0.01 | 0.37 | 100.10 | |
| 6-7010-20 | 218 | 232 | 76.07 | 13.21 | 1.27 | 0.20 | 0.65 | 4.20 | 4.29 | 0.10 | 0.05 | 0.01 | 0.01 | 0.38 | 100.45 | |
| 6-7430-40 | 218 | 232 | 50.09 | 17.45 | 9.47 | 6.18 | 8.64 | 3.47 | 0.73 | 1.07 | 0.26 | 0.12 | 0.02 | 1.33 | 98.84 | |
| 8-200-20 | 217 | 232 | 50.92 | 17.54 | 9.76 | 5.32 | 9.23 | 3.56 | 0.86 | 1.10 | 0.23 | 0.15 | 0.02 | 0.05 | 98.75 | |
| 8-420-40 | 217 | 232 | 50.40 | 17.17 | 9.61 | 5.25 | 9.07 | 3.53 | 0.91 | 1.13 | 0.24 | 0.15 | 0.02 | 1.63 | 99.12 | |
| 8-1000-20 | 217 | 232 | 55.65 | 17.30 | 7.48 | 3.70 | 6.66 | 3.80 | 1.57 | 0.94 | 0.33 | 0.12 | 0.05 | 1.53 | 99.14 | |
| 8-1280-00 | 217 | 232 | 55.96 | 16.87 | 7.36 | 3.25 | 6.77 | 4.13 | 2.10 | 0.90 | 0.36 | 0.15 | 0.05 | 0.97 | 98.88 | |
| 8-1380-00 | 217 | 232 | 51.13 | 16.89 | 9.64 | 4.14 | 7.54 | 4.10 | 1.07 | 1.21 | 0.35 | 0.13 | 0.03 | 2.60 | 98.84 | |
| 8-1740-60 | 217 | 232 | 70.50 | 14.10 | 3.49 | 0.35 | 1.81 | 4.35 | 4.89 | 0.54 | 0.24 | 0.04 | 0.07 | 0.52 | 100.95 | |
| 8-3140-60 | 217 | 232 | 51.70 | 16.95 | 9.16 | 3.39 | 7.92 | 3.43 | 1.63 | 1.07 | 0.40 | 0.16 | 0.04 | 3.25 | 99.11 | |
| 8-3940-60 | 217 | 232 | 56.28 | 17.20 | 8.10 | 3.16 | 6.91 | 4.10 | 2.12 | 0.99 | 0.39 | 0.13 | 0.04 | 1.04 | 100.45 | |
| 8-4860-80 | 217 | 232 | 60.32 | 16.43 | 6.48 | 1.88 | 5.02 | 4.76 | 2.49 | 0.95 | 0.48 | 0.13 | 0.06 | 1.10 | 100.10 | |
| 8-5560-80 | 217 | 232 | 67.90 | 14.75 | 4.03 | 0.81 | 2.20 | 4.53 | 3.50 | 0.46 | 0.13 | 0.05 | 0.08 | 0.81 | 99.26 | |
| 8-7410-20 | 217 | 232 | 61.24 | 15.74 | 6.00 | 1.95 | 4.47 | 4.61 | 2.48 | 0.88 | 0.26 | 0.08 | 0.07 | 1.07 | 98.86 | |
| 8-7050-60 | 217 | 232 | 73.40 | 12.94 | 2.75 | 0.88 | 1.80 | 2.67 | 3.68 | 0.19 | 0.11 | 0.05 | 0.01 | 1.00 | 99.49 | |
| 17-1010-20 | 217 | 232 | 57.37 | 17.72 | 7.27 | 3.52 | 6.78 | 3.97 | 1.52 | 0.96 | 0.35 | 0.12 | 0.05 | 1.51 | 101.15 | |
| 17-1200-10 | 217 | 232 | 54.95 | 17.45 | 7.26 | 3.00 | 6.37 | 3.86 | 1.52 | 0.96 | 0.37 | 0.11 | 0.05 | 2.72 | 98.63 | |
| 17-1310-20 | 217 | 232 | 53.22 | 16.06 | 8.26 | 2.45 | 4.91 | 3.65 | 1.03 | 1.37 | 0.45 | 0.13 | 0.04 | 6.86 | 98.44 | |
| 17-1600-10 | 217 | 232 | 48.22 | 16.32 | 9.74 | 4.23 | 8.02 | 3.60 | 0.91 | 1.31 | 0.33 | 0.16 | 0.03 | 2.50 | 95.38 | |
| 17-2100-20 | 217 | 232 | 49.27 | 16.79 | 9.78 | 4.26 | 8.17 | 3.74 | 0.85 | 1.29 | 0.31 | 0.16 | 0.03 | 3.03 | 97.69 | |
| 17-4300-10 | 217 | 232 | 63.62 | 15.69 | 4.21 | 1.57 | 3.85 | 4.57 | 2.30 | 0.58 | 0.25 | 0.09 | 0.08 | 1.50 | 98.32 | |
| 17-5160-70 | 217 | 232 | 72.35 | 14.54 | 2.41 | 0.32 | 1.21 | 4.77 | 4.53 | 0.35 | 0.10 | 0.02 | 0.09 | 0.68 | 101.40 | |
| 17-6940-50 | 217 | 232 | 49.15 | 17.85 | 9.20 | 5.91 | 8.84 | 3.40 | 0.44 | 1.07 | 0.28 | 0.16 | 0.02 | 1.54 | 97.87 | |
| 17-7420-30 | 217 | 232 | 70.48 | 14.05 | 2.71 | 0.73 | 1.82 | 3.83 | 3.87 | 0.43 | 0.12 | 0.04 | 0.07 | 0.57 | 98.73 | |
| 8-F.L. | 205 | 232 | 65.95 | 15.25 | 4.67 | 1.61 | 2.99 | 4.55 | 2.60 | 0.72 | 0.21 | 0.06 | 0.09 | 1.12 | 99.83 | |

CERTIFICATION: B. Caupl

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS,
NEVADA, U.S.A. 89431
PHONE (702) 356-5395

To: UNION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406

A8829139

Comments: ATTN: DANIEL L. CARRIER

# CERTIFICATE A8829139

UNION OIL COMPANY OF CALIFORNIA
PROJECT :
P.O.# : 480926

Samples submitted to our lab in Sparks, NV.
This report was printed on 4-JAN-89.

## SAMPLE PREPARATION

| CHEMEX CODE | NUMBER SAMPLES | DESCRIPTION |
|---|---|---|
| 205 | 1 | Rock Geochem: Crush,split,ring |
| 217 | 24 | Geochem:Ring only,no crush/split |
| 218 | 8 | Pulverize only - no crush/split |
| 232 | 33 | Total ICP digestion |

* NOTE 1:

Code 1000 is used for repeat gold analyses It shows typical sample variability due to coarse gold effects. Each value is correct for its particular subsample.

## ANALYTICAL PROCEDURES

| CHEMEX CODE | NUMBER SAMPLES | DESCRIPTION | METHOD | DETECTION LIMIT | UPPER LIMIT |
|---|---|---|---|---|---|
| 592 | 33 | SiO2 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 594 | 33 | Al2O3 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 586 | 33 | Fe2O3(total) %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 593 | 33 | MgO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 588 | 33 | CaO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 599 | 33 | Na2O %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 821 | 33 | K2O %: Whole rock | ICP-AES | 0.01 | 99.0 |
| 595 | 33 | TiO2 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 597 | 33 | P2O5 %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 596 | 33 | MnO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 542 | 33 | BaO %: Whole rock | ICP-AES | 0.01 | 99.00 |
| 475 | 33 | L.O.I. %: Loss on ignition | FURNACE | 0.01 | 99.00 |
| 540 | 33 | Total % | CALCULATION | 0.01 | N/A |

**Chemex Labs Inc.**
Analytical Chemists * Geochemists * Registered Assayers
994 WEST GLENDALE AVE., SUITE 7, SPARKS, NEVADA, U.S.A. 89431
PHONE (702) 356-5395

To: UNION OIL COMPANY OF CALIFORNIA
UNION GEOTHERMAL DIVISION
3576 UNOCAL PLACE, P.O. BOX 6854
SANTA ROSA, CALIFORNIA
95406
Project :
Comments: ATTN: DANIEL L. CARRIER

Page No. : 1
Tot. Pages: 1
Date : 4-JAN-89
Invoice # : I-8829139
P.O. # : 480926

# CERTIFICATE OF ANALYSIS A8829139

| SAMPLE DESCRIPTION | PREP CODE | | SiO2 % | Al2O3 % | Fe2O3 % | MgO % | CaO % | Na2O % | K2O % | TiO2 % | P2O5 % | MnO % | BaO % | LOI % | TOTAL % | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6-1090-00 | 217 | 232 | 65.17 | 15.17 | 5.37 | 2.03 | 3.96 | 4.02 | 3.63 | 0.68 | 0.19 | 0.08 | 0.06 | < 0.01 | 100.35 | |
| 6-2020-30 | 217 | 232 | 65.91 | 15.31 | 5.09 | 1.28 | 3.20 | 4.88 | 3.31 | 0.77 | 0.28 | 0.08 | 0.07 | 0.86 | 101.05 | |
| 6-4630-40 | 217 | 232 | 52.79 | 15.13 | 9.85 | 2.81 | 6.58 | 4.24 | 2.03 | 1.56 | 0.48 | 0.17 | 0.06 | 2.73 | 98.44 | |
| 6-5010-20 | 218 | 232 | 58.70 | 16.59 | 6.51 | 2.36 | 6.73 | 4.35 | 1.74 | 0.99 | 0.31 | 0.13 | 0.05 | 1.84 | 100.30 | |
| 6-5220-30 | 218 | 232 | 54.33 | 17.77 | 7.24 | 3.51 | 7.65 | 3.95 | 1.90 | 0.96 | 0.25 | 0.12 | 0.04 | 1.72 | 99.45 | |
| 6-5560-70 | 218 | 232 | 61.59 | 16.73 | 5.40 | 1.74 | 4.69 | 5.54 | 2.17 | 0.82 | 0.22 | 0.12 | 0.06 | 1.26 | 100.35 | |
| 6-6110-20 | 218 | 232 | 52.49 | 16.52 | 9.88 | 3.66 | 7.40 | 4.46 | 0.81 | 1.43 | 0.35 | 0.16 | 0.04 | 1.33 | 98.54 | |
| 6-6360-70 | 218 | 232 | 50.51 | 16.48 | 10.12 | 5.60 | 9.18 | 3.45 | 0.89 | 1.47 | 0.43 | 0.17 | 0.03 | 1.28 | 99.62 | |
| 6-6650-60 | 218 | 232 | 76.18 | 12.79 | 1.38 | 0.16 | 0.56 | 4.02 | 4.44 | 0.09 | 0.06 | 0.02 | 0.01 | 0.37 | 100.10 | |
| 6-7010-20 | 218 | 232 | 76.07 | 13.21 | 1.27 | 0.20 | 0.65 | 4.20 | 4.29 | 0.10 | 0.05 | 0.01 | 0.01 | 0.38 | 100.45 | |
| 6-7430-40 | 218 | 232 | 50.09 | 17.45 | 9.47 | 6.18 | 8.64 | 3.47 | 0.73 | 1.07 | 0.26 | 0.12 | 0.02 | 1.33 | 98.84 | |
| 8-200-20 | 217 | 232 | 50.92 | 17.54 | 9.76 | 5.32 | 9.23 | 3.56 | 0.86 | 1.10 | 0.23 | 0.15 | 0.02 | 0.05 | 98.75 | |
| 8-420-40 | 217 | 232 | 50.40 | 17.17 | 9.61 | 5.25 | 9.07 | 3.53 | 0.91 | 1.13 | 0.24 | 0.15 | 0.02 | 1.63 | 99.12 | |
| 8-1000-20 | 217 | 232 | 55.65 | 17.30 | 7.48 | 3.70 | 6.66 | 3.80 | 1.57 | 0.94 | 0.33 | 0.12 | 0.05 | 1.53 | 99.14 | |
| 8-1280-00 | 217 | 232 | 55.96 | 16.87 | 7.36 | 3.25 | 6.77 | 4.13 | 2.10 | 0.90 | 0.36 | 0.15 | 0.05 | 0.97 | 98.88 | |
| 8-1380-00 | 217 | 232 | 51.13 | 16.89 | 9.64 | 4.14 | 7.54 | 4.10 | 1.07 | 1.21 | 0.35 | 0.13 | 0.03 | 2.60 | 98.84 | |
| 8-1740-60 | 217 | 232 | 70.50 | 14.10 | 3.49 | 0.35 | 1.81 | 4.35 | 4.89 | 0.54 | 0.24 | 0.04 | 0.07 | 0.52 | 100.95 | |
| 8-3140-60 | 217 | 232 | 51.70 | 16.95 | 9.16 | 3.39 | 7.92 | 3.43 | 1.63 | 1.07 | 0.40 | 0.16 | 0.04 | 3.25 | 99.11 | |
| 8-3940-60 | 217 | 232 | 56.28 | 17.20 | 8.10 | 3.16 | 6.91 | 4.10 | 2.12 | 0.99 | 0.39 | 0.13 | 0.04 | 1.04 | 100.45 | |
| 8-4860-80 | 217 | 232 | 60.32 | 16.43 | 6.48 | 1.88 | 5.02 | 4.76 | 2.49 | 0.95 | 0.48 | 0.13 | 0.06 | 1.10 | 100.10 | |
| 8-5560-80 | 217 | 232 | 67.90 | 14.75 | 4.03 | 0.81 | 2.20 | 4.53 | 3.50 | 0.46 | 0.13 | 0.05 | 0.08 | 0.81 | 99.26 | |
| 8-7410-20 | 217 | 232 | 61.24 | 15.74 | 6.00 | 1.95 | 4.47 | 4.61 | 2.48 | 0.88 | 0.26 | 0.08 | 0.07 | 1.07 | 98.86 | |
| 8-7050-60 | 217 | 232 | 73.40 | 12.94 | 2.75 | 0.88 | 1.80 | 2.67 | 3.68 | 0.19 | 0.11 | 0.05 | 0.01 | 1.00 | 99.49 | |
| 17-1010-20 | 217 | 232 | 57.37 | 17.72 | 7.27 | 3.52 | 6.78 | 3.97 | 1.52 | 0.96 | 0.35 | 0.12 | 0.05 | 1.51 | 101.15 | |
| 17-1200-10 | 217 | 232 | 54.95 | 17.45 | 7.26 | 3.00 | 6.37 | 3.86 | 1.52 | 0.96 | 0.37 | 0.11 | 0.05 | 2.72 | 98.63 | |
| 17-1310-20 | 217 | 232 | 53.22 | 16.06 | 8.26 | 2.45 | 4.91 | 3.65 | 1.03 | 1.37 | 0.45 | 0.13 | 0.04 | 6.86 | 98.44 | |
| 17-1600-10 | 217 | 232 | 48.22 | 16.32 | 9.74 | 4.23 | 8.02 | 3.60 | 0.91 | 1.31 | 0.33 | 0.16 | 0.03 | 2.50 | 95.38 | |
| 17-2100-20 | 217 | 232 | 49.27 | 16.79 | 9.78 | 4.26 | 8.17 | 3.74 | 0.85 | 1.29 | 0.31 | 0.16 | 0.03 | 3.03 | 97.69 | |
| 17-4300-10 | 217 | 232 | 63.62 | 15.69 | 4.21 | 1.57 | 3.85 | 4.57 | 2.30 | 0.58 | 0.25 | 0.09 | 0.08 | 1.50 | 98.32 | |
| 17-5160-70 | 217 | 232 | 72.35 | 14.54 | 2.41 | 0.32 | 1.21 | 4.77 | 4.53 | 0.35 | 0.10 | 0.02 | 0.09 | 0.68 | 101.40 | |
| 17-6940-50 | 217 | 232 | 49.15 | 17.85 | 9.20 | 5.91 | 8.84 | 3.40 | 0.44 | 1.07 | 0.28 | 0.16 | 0.02 | 1.54 | 97.87 | |
| 17-7420-30 | 217 | 232 | 70.48 | 14.05 | 2.71 | 0.73 | 1.82 | 3.83 | 3.87 | 0.43 | 0.12 | 0.04 | 0.07 | 0.57 | 98.73 | |
| 8-F.L. | 205 | 232 | 65.95 | 15.25 | 4.67 | 1.61 | 2.99 | 4.55 | 2.60 | 0.72 | 0.21 | 0.06 | 0.09 | 1.12 | 99.83 | |

CERTIFICATION: B. Caplan

# APPENDIX E:
# MT Survey, Glass Mountain Prospect: Prepared for UNOCAL Geothermal

# Attachment IV

# CEC-500-2007-XXX-ATIV

# Glass Mountain Prospect magnetotelluric survey stations 1 to 17 Union Oil Company of California

This document is an attachment to a report funded by the California Energy Commission's Geothermal Resource Development Account (GRDA) Program. The GRDA Program did not fund this document, but the authors of the GRDA funded report have attached it as a supporting document.

The California Energy Commission wishes to thank the copyright holder, Calpine Corporation, for permission to republish this document in electronic format on the Energy Commission's website.

Please contact this document's author/publisher for additional information about the document.

UCA 07-3306

UNION OIL COMPANY OF CALIFORNIA

UNION GEOTHERMAL DIVISION

---

# GLASS MOUNTAIN PROSPECT

---

## MAGNETOTELLURIC SURVEY

OCTOBER 1982

STATIONS 1 TO 17

---

CGG
Development Geophysics
1475 Lawrence Street
Denver, Colorado 80202

TABLE OF CONTENTS


| | Page |
|---|---|
| Field Operations | 1 |
| Processing | 1 |
| 1. Principle | 1 |
| 2. Results | 5 |
| 2.1. Presentation | 6 |
| 2.2. Quality of the diagrams | 10 |
| 2.3. Main features | 12 |
| Fig. 1: Presentation of STATION 1 | 6 bis |
| Pl 1: Location map | |
| Annex 1: RESULTS OF PROCESSING | |

## FIELD OPERATIONS

The operations took place between October 13 and October 29th; they were conducted by F. Hallonet assisted by T. Raoult.

An operation report has already been submitted to Union Oil Company of California. Seventeen MT soundings have been recorded, using the single site technique. A location map is attached (station numbers range from 1 to 17, whereas after processing prefix A B or C is sometimes added).

## PROCESSING

Processing has been carried out in the CGG Denver processing center. Results are given in Annex 1 and discussed thereafter (paragraph 2.2.). The principle of CGG technique and a general presentation are first described (par. 1 and 2.1.).

### 1. PRINCIPLE

The different phases are as follows:

#### 1.1. Demultiplexing of field tapes

Field tapes have been recorded on a standard 9 track tape transport (Kennedy 9700). The CGG MTFT1 format has been used.

Demultiplexed tapes are first created. The headers and data are copies of the field information; no selection is performed. The CGG MTDT1 format has been used.

#### 1.2. Quality control - Editing

Thanks to the detailed observer logs and to the chart recorder monitors, the quality of each file is appraised.

Highly noisy parts of each record may be suppressed. High frequency (HF), medium frequency (MF) and low frequency (LF) files are then gathered to "build" one station.

For each station, 6 to 12 files have generally been recorded. The most expensive but most efficient way to take advantage of this lengthy recording technique is, to build 2 or 3 independent stations, called for instance: Station A1, B1 and C1, to process them independently, and to deliver the best quality one, by retaining each best file.

## 1.3. Spectral Analysis - Calibration corrections

The spectral analysis is performed by using a standard F.F.T. algorithm, after the necessary preliminary steps have been applied: band pass filtering, whitening and tapering.

Each record is first divided into independent segments; the length of each segment is chosen according to the maximum period studied (T max) and to the number of samples ($2^N$). The F.F.T. algorithm is then applied to each segment.

The parameters used in this case are as follows:

| Domain | Recording time (mn) | Number of segments | Number of samples/ segment | Frequency domain studied T min (S) - T max (S) |
|---|---|---|---|---|
| HF | 1 | 59 | 512 | .0078 - 0.88 |
| MF | 7 | 24<br>6 | 4096<br>1024 | .08 - 1.5<br>1.3 - 3.6 |
| LF | 35<br>to<br>105 | 16 to 48<br>4 to 12<br>1 to 3 | 512<br>2048<br>8192 | 3 - 12<br>10 - 48<br>40 - 200 |

The results of the Fourier transform are corrected for the sensitivity of the sensors, the amplification coefficients and the frequency response of the system.

The E and H field are thus expressed in mV/Km and gamma.

A specific coefficient (real and independent of T) is first applied. Its expression is:

- magnetic channel

$$C_H = \frac{10^4}{2048 \times 16 \times gain} \times \frac{1}{S\,(mV/\gamma)}$$

S is generally equal to 50 mV/ $\gamma$

$$H(\gamma) = C_H \times H_{FFT}$$

- telluric channel

$$C_E = \frac{10^4}{2048 \times 16 \times gain} \times \frac{10^3}{L(m)}$$

L is the length of the telluric dipole in meters

$$E(mV/Km) = C_E \times E_{FFT}$$

A calibration coefficient (complex and dependent on T) is then applied. It depends on the frequency response of the sensors and of the system.

1.4. Calculation of Impedances with 2 references: (Single site MT = OPTION 1)

Six complex impedances = Zxy(T), Zyx(T), Zxx(T), Zyy(T), Zzx(T) and Zzy(T) are to be calculated for different periods (T) over specific windows ($\Delta T$).

A geometric progression has been chosen for T (13 values/decade); the width of each window is thus automatically defined; the spectrum averaging ($\Sigma EiHj$) is performed over a number of periods which depends on the actual central period T; this number varies from 6 (around T max), to 50 (around T min).

Two algorithms are tested for each impedance, corresponding to two different local references.

- Algorithm 1: Hx and Hy are taken as references. Possible specific telluric noise will be eliminated. Impedances can be underestimated due to possible specific magnetic noise.

  Algorithm 2: Ex and Ey are taken as references. Possible specific magnetic noise will be eliminated. Impedances can be overestimated due to possible specific telluric noise.

1.5. Invariant diagrams

From these impedances, three "invariants" are calculated (i.e. independent of the azimuth of the array in the field)

- $\rho INV = 0.2\ T|ZxxZyy - Zxy\ Zyx|$

  it is close to the geometric average of the conventional extreme: $\rho xy$ and $\rho yx$. The corresponding phase is not computed.

- TIPPER:

$$TIP = \sqrt{|Zzx|^2 + |Zzy|^2}$$

  It is a "non layered" earth indicator; it is equal to 0 on a 1D earth; its maximum should be equal to 1, we think. It is however very sensitive to noise on HZ and to nearby electromagnetic sources which do not generate plane waves

- SKEW:

$$S = \frac{|Zxx+Zyy|}{|Zxy-Zyx|}$$

it is a 3D indicator; it should be equal to 0 on 1D and 2D earths; it is however much influenced by noise on E and H components.

Quality control:

Invariant diagrams, versus T, are plotted. The diagrams corresponding to each reference (INV1 and INV2) and to each set of files (station A,B,C) are compared. The decision is then made upon the final file and the final algorithm, to be used for the end of the processing.

The graphic display of these diagrams based on histograms is specific to CGG. Although, the picture may not look nice, we feel it is an efficient way to discriminate between signal and noise, and to estimate bias and the final quality of the data.

Coherencies:

An average coherency diagram, versus T is attached to each invariant. It is a kind of phasor coherency; it measures the discrepancy between the results obtained from the two algorithms. The coherence is smaller than 1; it is equal to:

$$COH\ (INV) = \frac{INV1}{INV2} \qquad COH\ (SKEW) = \frac{SKEW\ 1}{SKEW\ 2} \text{ or } \frac{SKEW\ 2}{SKEW\ 1}$$

In Annex 1, where the results are displayed, INV1 and INV2 are generally shown, so that the bias can readily be estimated and the final choice confirmed. INV1 has generally been considered as the best estimation.

## 1.6. Determination of the Main Directions. Polar Diagrams

The study of the variations of the impedances with the azimuth of the sensors, allow to define the main directions of the geological structure beneath each station.

Rather than defining the azimuth of these directions automatically for each period through a composite parameter, we plot polar diagrams for each impedance for a reasonably wide window, and define the angle visually as the best compromise from three independent determinations.

We feel this procedure allows partly to discriminate between superficial geologic noise and deep information, and that it is more consistent with a further 1D or 2D interpretation.

Three windows were selected in this case, best related to the depth of investigation, and taking into account the quality of signal.

| Domain | T min (S) - T max (S) |
|---|---|
| HF | 0.04 - 0.08 |
| MF | 0.1 - 0.6 |
| LF | 11 - 22 |

An average single strike azimuth, valid for the whole spectrum, is defined as often as possible, as the best compromise between these independent sources of information. When this cannot be done two different azimuths are chosen and two sets of rotated diagrams are calculated.

The choice of the rotation angle from the polar diagrams, is explained thereafter (see Results 2-1Ac and 2-1I).

1.7. Final Diagrams along the Main Directions

Two apparent resistivity diagrams ($\rho xy$ and $\rho yx$) and two phase diagrams ($\phi xy$ and $\phi yx$) are finally calculated along the main directions from the selected files and algorithms, for each station.

These diagrams are plotted as the previous invariant ones.

An average coherency diagram is attached to each direction; the same one is plotted on top of resistivities and phases. It is a kind of phasor coherency which measures again the discrepancy betwen the results obtained for the two algorithms:

$$COH\ (xy) = \frac{RHOxy1}{RHOxy2}\ ,\quad COH(yx) = \frac{RHOyx1}{RHOyx2}$$

An ellipticity diagram along the main directions is also calculated and plotted. The expression is:

$$ELL = \left|\frac{Zxx-Zyy}{Zxy+Zyx}\right|$$

It is a 3D indicator which complements the SKEW.

2. RESULTS

For each station, a minimum of 12 documents is generally delivered (see Annex 1).

## 2.1. Presentation

A) Introduction: One page summarizes the field and processing information and explains the symbols used (fig.1).

a) Date of recording, number and index of files: The number of each file of each domain (HF,MF,LF) corresponds to that found on the field and demultiplexed tapes (HF = files 71,75,78 and 81...).

b) Field array: It is described with redundancy. The azimuth of Ex and Ey in the field, is given in three different ways = in centesimal divisions as given on the observer logs (from 1 to 400 grades), in sexagesimal divisions (from 1 to 360 degrees), and more conventionally (from 1 to 180°, E and W).

c) Strike

- The angle of rotation (ROT in degrees) is measured on the XY polar diagram. It is the angle by which the "arrow" must be rotated, to reach the minimum value of RHOXY, showed with a - sign.

  The angles are positive towards the left (trigonometric convention).

  The "arrow" represents Ex in the field.

  The actual value shown (ROT) is an average between different determinations as explained above.

- The azimuth of EX (AZ.EX) is calculated from the azimuth of Ex in the field and from the rotation angle; it is the azimuth of the electric field EX, after rotation.

- The strike azimuth, from Exy and Hxy is equal to AZ.EX or AZ.EX ± 90°. It is supposed to be the azimuth of the strike as determined from the horizontal components after the undetermination has been solved by using Hz. How is it solved?

  The strike is defined by the maximum of yz on the polar diagrams (or by the minimum of xz).

  Az.EX is compared to that strike, defined by Hz.

  If the discrepancy is smaller than ± 45°, the final strike azimuth is equal to Az.Ex. If the discrepancy is greater than ± 45°, the final strike azimuth is equal to Az.Ex ± 90°.

- $\rho E, \rho H, \rho xy, \rho yx$ =

  - $\rho xy$ corresponds to Ex and Hy after rotation

  - $\rho yx$ corresponds to Ey and Hx after rotation

UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 1

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/25 | 71 | | 70 | | 72-73 | |
| 10/26 | 75 | C | 74 | C | 76 | C |
| 10/27 | 78 | B | 77 | B | 79 | B-A |
| | | A | 80 | A | | |

| FIELD ARRAY | AZ. | Cent.º | Sex. º = Azimuth |
|---|---|---|---|
| | Ex | 75 | 67.5 = 67°5E |
| | Ey | 375 | 337.5 = 22°5W |

| STRIKE from Exy, Hxy | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| | 77°5E | 170 | 257.5 = 77.5E | XY | YX |
| STRIKE from Hz | 48°E | | | | |

## COMMENTS

### FIELD

10/25 Low Signal, thunderstorm

10/26 = Idem

10/27 = OK - Sunny - no wind
snow on the ground
no thunderstorm

### PROCESSING

Fair

HF: $\rho E \# \rho H$

LF: $\rho E < \rho H$

Fig.1. Presentation of station 1

- From our initial choice = $\rho xy < \rho yx$
- $\rho E$ corresponds to the electric polarization, i.e. to the electric field parallel to the strike. it is sometimes called $\rho$ parellel.
- $\rho H$ corresponds to the magnetic polarization i.e. to the magnetic field paralled to the strike, it is sometimes called $\rho$ perpendicular
- When strike azimuth = Az.Ex $\Rightarrow \rho E = \rho xy$ and thus $\rho H = \rho yx$
- When strike azimuth = AzEx $\pm$ 90° $\Rightarrow \rho E = \rho yx$ and $\rho H = \rho xy$.
- Strike from Hz:
  It is the azimuth corresponding to the maximum of yz (or to the minimum of xz) on the polar diagrams.

  If this value is close to the strike azimuth shown above (difference smaller than 30°) one knows that there is no ambiguity on the determination of $\rho E$ and $\rho H$.

  If the difference between these two values is of the order of 30 to 45°, one knows that there is some ambiguity on the determination of $\rho E$ and $\rho H$.

d) Comments: The field comments concern the location of the station, the weather conditions and the quality of the signal; they are taken from the observer logs and from the monitors.

The processing comments concern the quality of the final diagrams and describe some specific features, of interest for interpretation.

B) RHO INV 1, RHO INV 2:

- RHO INV 1 refers to the invariant resistivity diagram corresponding, to algorithm 1 as defined previously = telluric noise eliminated, underestimation due to possible magnetic noise.
- RHO INV 2 = magnetic noise eliminated, overestimation due to possible telluric noise.
- (OPT = 1) stands for single site MT.
- A1...A7... is the name of the MT station.
- Periods range from 0.01 s (to the left), to 1000.00s (to the right
- Apparent resistivities generally range from 1.00 ohm. m (bottom line) to 1000.00 ohm.m (top line).
- Average coherency varies from 0 to 1.

- No selection based upon coherency has been made among the experimental values prior to the representation; this explains why poor quality stations appear as clouds of black dots rather than as a blank page. Such a selection will probably be performed for the next surveys.

C) RHO YX 1 0170 0170 0170

- (OPT = 1) stands for single site MT.
- 0170 refers to the rotation angle($\stackrel{\circ}{=}$) as defined in 2.1.A.C; the three successive values correspond to the three domains (HF, MF, LF); a different angle could be used for each domain; it is not the case here.
- RHO YX 1 corresponds to EY and HX after rotation and to algorithm 1.

D) PHA YX 1 0170 0170 0170: It is the phase diagram corresponding to $\rho$YX 1. The convention is specific to CGG:

- on top of a homogeneous half space = $\phi = 0^{\circ}$
- on top of an infinitely conductive substratum = $\phi = -45°$
- on top of an infinitely resistive substratum = $\phi = +45°$

E) RHO XY 1 and PHA XY 1: Similar to above.

F) SKE: It is the SKEW diagram.

An arithmetic scale, (from 0 to 5) would be more appropriate than a logarithmic one. This modification will be undertaken soon.

This diagram complements the discrete values of SKEW shown on the polar diagrams.

G) TIP: It is the TIPPER diagram.

NOTA = For this survey, by mistake, $(TIP)^2$ has been shown instead of TIP. A correction has thus to be applied. The TIP diagram should run midway between the present diagram and the horizontal line "1", dispersion should also be divided by 2.

An arithmetic scale would also be more appropriate.

H) ELL 1 0170: It is the Ellipticity diagram after rotation (170°).

Ellipticity is very sensitive to the azimuth of the array. The choice of an average rotation angle for the whole spectrum may be more dramatic for this parameter than for others.

An arithmetic scale would still be more appropriate.

I) Polar Diagrams:

- One or more sets of polar diagrams are drawn for each domain generally (LF,MF,HF); the domain and the selected "period window" (T MIN - T MAX) are given as subtitles.

- The results corresponding to the two algorithms are sometimes represented; they appear as "Combinaison 1" and "Combinaison 2".

- SKEW and TIPPER are calculated for the selected "period window" also.

- The azimuth of Ex in the field is mentioned.

- The "arrow" on each diagram represents Ex in the field.

- Three different diagrams are generally drawn =

  XY = RHOXY = $0.2T|ZXY|^2$ is plotted along EX with a logarithmic scale (the central value and the length of the module is mentioned).

  The minimum and maximum of RHOXY are indicated with + and - signs.

  The maximum value of RHOXY is mentioned; it should correspond to the average value measured on the RHOYX diagram for the same periods.

  The azimuth of the minimum and the rotation angle are also mentioned.

  A "circular" shape for such a diagram corresponds to an isotropic situation i.e. a layered earth or a very specific 3D situation.

  An "elongated" shape allows to define the main directions of 2D or 3D structures.

  XX = RHOXX = $0.2\ T|ZXX|^2$ is plotted along EX in a way similar to that used for XY.

  The central value and the module are hopefully much lower than for XY however.

  On top of a layered earth all the values should be smaller than 0.05.

  On top of a 2D structure one should obtain a symmetrical clover leaf.

  On top of a 3D structure, one should obtain a disturbed clover leaf.

YZ = |ZZY| is plotted along EX with a logarithmic scale.

The minimum and maximum are indicated with + and - signs; the maximum value is also indicated.

This maximum value should not be very different from the Tipper value mentioned above.

The maximum of YZ plotted along EX defines the strike of the structure, since

$$Hz = Zzy\ Hy \quad (Zzx=0)$$

for a structure parallel to EX

NOTE: YX,YY or XZ, polar diagrams, could be plotted, instead of XY,XX and YZ.

They would then be at right angle to the latter, and the strike for instance would be defined by the minimum of XZ.

## 2.2 Quality of the diagrams

A) General Comments: "Average quality" is the qualificative that best applies to the whole survey:

- The HF and LF domains are generally above average,except for one or two stations.
- The MF domain is generally below average except,for one or two stations.

The $\rho$INV diagrams appear often of better quality than $\rho$xy or $\rho$yx; it may be due to the fact that an "average" angle has been chosen for the whole spectrum.

The "phase" diagrams with the scale chosen (10°=1cm) appear with a greater dispersion than the resistivity ones; this information however, as it stands, will undoubtedly help for the quantitative interpretation.

The SKEW diagrams are generally acceptable,except in MF.

The TIPPER diagrams are generally acceptable, except in MF; for stations 3 and 16, the quality is poor within the whole spectrum.

The following table summarizes the quality, with four grade scale, from A (good) to D (poor).

| Station | INV | YX | XY | SK | TIP |
|---|---|---|---|---|---|
| 1 | A | A | A | B | C |
| 2 | C | B | D | B | C |
| 3 | B | B | C | C | D |
| 4 | B | B | C | B | B |
| 5 | B | A | C | B | B |
| 6 | A | A | B | B | C |
| 7 | C | C | C | B | B |
| 8 | A | B | B | C | C |
| 9 | A | A | A | B | B |
| 10 | A | A | B | B | B |
| 11 | A | A | A | B | C |
| 12 | A | A | B | B | C |
| 13 | A | A | B | B | C |
| 14 | A | A | B | B | B |
| 15 | A | A | B | B | B |
| 16 | B | B | B | C | D |
| 17 | A | B | B | B | C |

NO CHANGES

B) Noise Sources:

- Cultural noise has never been a problem for this survey.
- Thunderstorm activity has sometimes been a problem; some stations have been recorded 2 to 3 times over 2 and sometimes 3 days. until the signal/noise ratio was considered satisfactory.
  - Station 1, started on October 25th was finally considered perfect on October 27th.
  - Station 2 should probably have been recorded, one more day.
- Unconsolidated soil + wind (i.e. mechanical noise) may account for some MF noise.
- Low natural activity probably accounts for the rest of MF poor quality, although a careful study of the spectra would be necessary before such a conclusion is drawn.

C) Average diagrams: To draw an average resistivity or phase diagram, taking into account the histograms, the bias, the coherency and some knowledge of the geology, is part of the interpretation procedure.

However such an attempt has been made, and a working copy called "Annex 2" displays these diagrams.

It is our belief that these diagrams should match with diagrams obtained any other time by anybody else, i.e. under different signal/noise circumstances. In other words, we feel that the results obtained from this survey are as close as they can be, from what Magnetotelluric is able to provide, in this area.

## 2.3. Main features

An appraisal of the main features requires a thorough interpretation and the display of qualitative maps ($\rho a$, $\phi a$, polar diagrams). Although such a work has not been attempted, some conclusions can be drawn, at first glance.

A) A four layer distribution seems valid for all the stations:

- a resistive top layer
- a conductive intermediate layer
- a very thick resistive substratum
- a deep conductive half space probably related to higher temperature, as found generally in this part of the U.S.

Station 9 shows probably the most conductive intermediate layer.

B) "Static corrections" related to superficial conductive bodies have probably to be applied to some stations (3-8-11-12) since $\phi xy \# \phi yx$ and $\rho yx // \rho xy$).

C) SKEW values are generally lower than 0.3 in LF = stations 3-7 and 17 show the highest values.

D) TIPPER values are generally lower than 0.3 = stations 1-3-4-11-15-16 and 17 show the highest values (the quality of station 3 is doubtful however).

**UNION OIL COMPANY OF CALIFORNIA**

GEOTHERMAL DIVISION

# MAGNETOTELLURIC SURVEYS
in California

- GLASS MOUNTAIN

## OPERATION REPORT

October - November 1982

CGG
Development Geophysics
1475 Lawrence Street
Denver, Colorado 80202

# INTRODUCTION

At the request of UNION OIL OF CALIFORNIA (Geothermal Division), CGG carried out a magnetotelluric survey over three prospects in the state of California.

- Glass Mountain, close to Medicine Lake or about 40 miles east of Mount Shasta in Siskiyou County.

The field operations took place between October 13 and November 17, 1982, and were conducted by F. Hallonet assisted by T. Raoult. The processing was carrried out at CGG Denver by S. Wong under the supervision of P. Andrieux.

CREW COMPOSITION

Personnel

1 Party Manager, geophysicist

1 Senior Observer

1 Mechanic

3 Helpers

These employees performed the work from different bases according to the prospects:

- Mount Shasta for GLASS MOUNTAIN prospect;

[redacted]

Equipment

The technical equipment supplied to perform the survey included:

1 complete M3T data acquisition unit

1 two channel oscilloscope

1 pair analog filter

4 coil magnetometers, type CM10

16 non-polarizable cadmium electrodes

6 x 75 meter magnetometers cables

4 x 150 meter telluric cables

1 2kVA 50 Hz power generator

1 set connectors, tools, spare parts, magnetic tapes, chart papers

The M3T unit is installed in 4WD Ford Van and comprises the following elements:

- a unit for preamplification and filtering with 6 channels (3 telluric, 3 magnetic),

- a 6 channel graphic recorder (MFE type 1600),

- a control unit for multiplexing, digitization and amplification, carried out with a 16 bits microprocessor,

- an interface between the control unit and the recorder (Kennedy 9218),
- a keyboard-printer for conversing with the microprocessor (Texas Instrument Silent SR 743),
- a magnetic tape recorder: 9 tracks - 800 bpi (Kennedy 9700),
- two selective analog filters for filtering a part of the graphic recorded signals (type Rockland 1000 F).

The various functions performed by this equipment are:

Processing of analog signals. There are six identical channels, each of them performing the following functions:

- Preamplification (differential) - impedance:

  $10^{10}$ ohms - noise: 1,5 µV peak to peak from 0.01 to 1 Hz at gain 100

  drift: $\pm$ 2 µV/°C - gains : 5, 10, 20, 50, 100, 200

- High pass filters: 0.005 Hz$\leftarrow$ 3 dB ; 6 dB/octave
  0.2 Hz$\leftarrow$ 3 dB ; 12 dB/octave
- Low pass filters : 100 Hz$\leftarrow$ 3 dB ; 24 dB/octave
- Notch filters : 50 Hz and 150 Hz or 60 Hz and 180 Hz
- SP bucking
- Antialiasing filters: 1 Hz$\leftarrow$ 3 dB ; 36 dB/octave
  16 Hz$\leftarrow$ 3 dB ; 36 dB/octave
  128 Hz$\leftarrow$ 3 dB ; 36 dB/octave
- Amplification gains : 1 - 3 - 30 - 100 - 200
- Selecting the frequency range (HF = 0,2 to 128 Hz, MF = 0,2 to 16 Hz, LF = 0 to 1 Hz or 0.005 to 1 Hz). However, low and high cut filters may be combined in any manner and remain independent for each channel.
- Graphic display of recorded traces. The plotter has six traces (type MFE 1600). Each channel comprises:
  - preamplifier with 9 sensitivities from 10 V/cm to 20 mV/cm

  - 50 mm wide track

- Digitization, automatic gain, control unit, multiplexing. Digitization and amplification are carried out by a single unit for all six channels.

  - voltages are converted on 12 bits (11 bits + sign)
  - sampling rate: 4 - 64 - 512 Hz
  - conversion time: 24 μs
  - dynamic range: ± 10 volts
  - automatic gain: 1 - 2 - 4 - 8

These operations are carried out with a 16 bit microprocessor with 10 k-words of RAM* and 16 k-words of EPROM**.

Interfacing with the tape recorder is done by a board with 2 k-words of RAM.

- Magnetic tape recorder: the recorder (type Kennedy 9800) works in the stop/start mode
- 9 tracks - 800 bpi - NRZI norm
- 1/2 inch - 1200 feet
- Recording speed: 25 ips - odd parity.

One field tape contains several stations. Each record is made of several blocks, each block has 3010 bytes. The first block is a header which contains the necessary information for processing: name of the station, domain, length of the telluric lines, type of magnetometers, etc. The next blocks are the signal blocks. Samples are multiplexed. Each sample needs two bytes (12 bits for the converted value and 4 bits for the binary gain used during the recording).

*RAM = Random Access Memory
*EPROM = Erasable Programmable Read Only Memory

- Dialogue

Carried out with a keyboard-printer (type Texas Instrument Silent SR 743) - (asynchronous liaison - 300 bands - type RS 232 C).

- Power Supply

220 V (50 or 60 Hz) generator - 1 KWA.

## OPERATIONS

A classical five component array was used and the following components were recorded:

- The electrical field in two horizontal directions at right angles (Ex and Ey)
- The magnetic field in three directions at right angles, two of them (Hx and Hy) being parallel to the electrical dipoles (Hx//Ex and Hy//Ey), the third one being vertical.

### Telluric Lines

Five hundred feet of telluric lines were used. The length was occasionally increased or reduced in order to minimize noises (as from roads or trees).

The electrodes were of the non-polarizable type, fitted with cadmium chloride. To improve the ground contact, two pots were used for each electrode with salted water and bentonite added each time. In this way it was possible to acquire acceptable data even in a pumice area, which was frequently the case. The telluric lines were laid out as near to horizontal as permitted by the local topography.

### Magnetometers

The magnetometers were of the CM10 induction type. They comprise 600,000 turns of copper wire wound around a core of mumetal. They are equipped with a preamplifier and have a very flat response over a broad frequency range due to a special feedback system. These magnetometers are cylinders 1.8 meters long and 15 to 20 centimeters in diameter.

The horizontal magnetometers were carefully positioned and levelled within a fraction of a degree. They were buried in trenches

30 to 50 centimeters deep and covered with a board, on which a polystyrene foam pad was attached. Then the board was covered with dirt in order to protect the magnetometers against any damage from vibrations or thermal variations.

The vertical magnetometer was placed vertically in a hole, dug out with a post hole digger, levelled and then covered with a large plastic bucket to protect it, as well as the horizontal magnetometers, against any artifical noise. Each magnetometer was located about 10 meters from the others to avoid interferences.

All the MT sites to be surveyed were selected by a UNION field representative; the locations given were used except on the last prospect (Excelsior) where some sites were slightly displaced to move away from power lines.

Quality Control in the Field - Recording Time

Each site having been well prepared and carefully set up, the quality control in the field was done in two ways by the observer:

- permanently checking the analog display of the five traces, first of all before recording to know if the signal was good and not noisy and then during the recording to note any abnormal event.

- bandpass filtering to check the coherency existing between the magnetic and the electric fields in given frequency window.

The minimum recording times were:

- HF: 2 x 1 minutes
- MF: 2 x 7 minutes
- LF: 3 x 35 minutes

## WORK PERFORMED

### GLASS MOUNTAIN PROSPECT

| | |
|---|---|
| Base: | Mount Shasta |
| Starting date: | October 13, 1982 |
| Completion date: | October 29, 1982 |
| Number of sites surveyed: | 17 |
| Number of effective recording days: | 11 |
| Number of standby days: | 4 (October 21, 25 and 26) |
| Number of testing days: | 2 (calibration tests October 13 and 23) |
| Total days in the field: | 17 |

Denver, December 30, 1982
F. HALLONET

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : | MAGNETOTELLUR REPORT |
|---|---|---|---|---|---|
| RAOULT | 14-10-82 | 404 25 11 | | UNION | |

Processing :

Sketch : N

Station : TEST sur

Tape : 1

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ex | Hy | Hy | Hy | 152 m / 500' | 40 kΩ | 25gr | Ex | | | Hx |
| Mag Number | | 16 | | 11 | 5 | 9 | 152 m / 500' | 40 kΩ | 25gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 1 | MF | Gain | 50 x 300 | 20 x 100 | 50 x 300 | 20 x 100 | 20 x 100 | 20 x 100 | 7' |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | 50mV/δ | |
| 2 | HF | Gain | 50 x 300 | 20 x 100 | 50 x 300 | 20 x 100 | 20 x 100 | 20 x 100 | 11' |
| | | Sensibil. | " | " | " | " | " | " | |
| 3 | BF | Gain | 50 x 30 | 20 x 3 | 50 x 30 | 20 x 3 | 20 x 3 | 20 x 3 | 35' |
| | | Sensibil. | " | " | " | " | " | " | |
| | | Gain | " | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Tellur assez bruité

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 27.10.82 | 404-25-11 | GLASS MT. | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

Station : 1

Tape : 4

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 7 kΩ | 75 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 7 kΩ | 375 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| ✓77 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' | |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | | | |
| ✓78 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| ✓79 | BF | Gain | 50x30 | 10x3 | 50x30 | 20x3 | 10x3 | | 106' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | |
| ✓80 | MF | Gain | 50x100 | 50x30 | 50x100 | 50x30 | 20x100 | | 7' | Pas de "Pets" |
| | | Sensibil. | " | " | " | " | " | | | |
| 81 | HF | Gain | 50x100 | 50x30 | 50x100 | 50x30 | 20x100 | | 1' | ⊗ |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | Soleil. Neige au sol. Pas de |
| | | Sensibil. | | | | | | | | |

E.N.D.T. FIN de BANDE 4

Station en Foret

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 25-10-82 | 4104 25 11 | GLASS MT | UNION |

# MAGNETOTELLURI REPORT

Processing : Combined in [illegible] MTTE
([illegible] ID)
↳ Delphe 5200 → (N-8200)
↓
Σ

Sketch :

N

Station : 1

Tape : 4

+

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 10kΩ | 75gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 10kΩ | 375gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 70 | MF | Gain | 50 x 30 | 20 x 30 | 50 x 30 | 20 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | |
| 71 | HF | Gain | 50 x 30 | 20 x 30 | 50 x 30 | 20 x 30 | 20 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 72 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 10 x 3 | | 35' |
| | | Sensibil. | " | " | " | " | " | | |
| 73 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 10 x 3 | | 35' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Enregistrement man[illegible]
Ne pas TRAITER
Signal très faible
"Pets" d'orage trop fr[illegible]

Pluie - Vent - Neige.
"Pets" d'orage

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 26.10.82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURIC REPORT

Processing :

Sketch :

N

Station : 1

Tape : 4

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 7 kΩ | 75gr | Ex | | | Hx |
| Mag Number | | 11 | | S | 16 | | 500' | 7 kΩ | 375gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 74 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | |
| 75 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 76 | BF | Gain | 50x30 | 10x3 | 50x30 | 20x3 | 10x3 | | 136' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Enregistrement mauvais

Ne pas TRAITER

Signal trop faible et "Pets" d'orage trop f

Vent - Soleil et Nuag

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 28-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing : 16:35 17:10 17:46 17:47

Temps échantillon

BF Delete 5500 – 5650

– 16850 – 16 – 17500

MF1 Delete 15360 – N

Sketch :

N

Station : 2

Tape : 5

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 445' | 10kΩ | 355gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 515' | 10kΩ | 255gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 12 | MF | Gain | 20x300 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | |
| 13 | HF | Gain | 20x300 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 14 | BF | Gain | 20x100 | 10x3 | 20x100 | 20x3 | 10x3 | | 107' |
| | | Sensibil. | " | " | " | " | " | | |
| 15 | MF | Gain | 20x300 | 20x30 | 20x300 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | ⊗ |
| 16 | HF | Gain | 20x300 | 20x30 | 20x300 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Thin [illegible] on Ey !!

Signal moyen. Ex.Hy → o.
Ey.Hx → m
correl.

Decrochements sur Ey
Ne pas TRAITER la mn
les 1° 35mn, puis les 2°
(Recentrage Signal)

Centre et Mags sur Plate forme dégagée

Sol en Pierre Ponce – Station a cote d'une coulee

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 23-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Station : 3

Tape : 4

Processing :

Sketch :

N

+

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 8kΩ | 35gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 530' | 6kΩ | 335gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| ✓65 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | | |
| ✓66 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| ✓67 | BF | Gain | 50x30 | 10x3 | 50x30 | 10x3 | 10x3 | | 107' |
| | | Sensibil. | " | " | " | " | " | | |
| ✓68 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | |
| ✓69 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Ne pas prendre les 2 mm suiv
1e 35 mm (Saturation Hz, Recent
⊗ les 2e 35 mm sont ass
Les 1e et 3e : signal f
Telle assez instable

Nuageux. orageux - Vent.

Station en Foret.

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 28-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURIC REPORT

Station : 4

Tape : 5

Processing :

BF 10 40 11 16

8500 - 8650
16850 - (11 - 8500)

Sketch :

N

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 437' | 17 kΩ | 75 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 26 kΩ | 375 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 6 ✓ | MF | Gain | 20 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | 1 | 50 mV/γ | 1 | 50 mV/γ | 50 mV/γ | | |
| 7 ✓ | HF | Gain | 20 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 8 ✓ | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 10 x 3 | | 110' |
| | | Sensibil. | " | " | " | " | " | | |
| 9 ✓ | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | |
| 10 ✓ | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 11 ✓ | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 20 x 3 | 10 x 3 | | 35' |
| | | Sensibil. | " | " | " | " | " | | |

Remarks :

⊗

Ne pas TRAITER la mn qui 1° 35 mn, puis la mn qui 2° 35 mn (Recentrage Signa Petits decrochements sur Ey Bon Signal.

TRES BON SIGNAL

Station en forêt

Sol en pierre Ponce. Station à côté d'une coulée de l

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 27-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Station : 5

Tape : 5

**Processing :**

A - Init : 3 → Debut 1660 m (N = 820)

→ B - 4+5+3 → Debut 8300 m (N = 15)

?

**Sketch :**

N

+

C30 : 167.60 m

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 550' | 5kΩ | 235gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500 | 5kΩ | 135gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 1 | MF | Gain | 20 x 300 | 50 x 30 | 50 x 100 | 50 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | 1 | 50mV/F | 1 | 50mV/F | 50mV/F | | |
| 2 | HF | Gain | 20 x 300 | 50 x 30 | 50 x 100 | 50 x 30 | 20 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 3 | BF | Gain | 20 x 30 | 20 x 1 | 20 x 30 | 10 x 3 | 10 x 3 | | 110' |
| | | Sensibil. | " | " | " | " | " | | |
| 4 | MF | Gain | 20 x 300 | 50 x 30 | 20 x 300 | 50 x 30 | 50 x 100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | |
| 5 | HF | Gain | 20 x 300 | 50 x 30 | 20 x 300 | 50 x 30 | 50 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

**Remarks :**

Ne pas traiter les 4 mm qui les 2 premières 35 mm (main - Petits décrochements sur Ex ?

⊗

Soleil - Pas de vent. Neige sol fondante.

Station en forêt

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 18.10.82 | 404.25.11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

+

- Sur Ey : dénivellé de ≃ +30m entre le centre et électrode lointaine.
- Ey = 550'

Station : 6

Tape : 2

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 10kΩ | 200gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 550' | 10kΩ | 100gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 32 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' ⊗ | * Le Mag ne fonctionne plus en gamme "RAPIDE" → d'où pas de travail en gamme "LENTE" |
| | | Sensibil. | 1 | 5mV/δ | 1 | 5mV/δ | 10mV/δ * | | | |
| 33 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 11' | - quelques petits pets sur Tellu |
| | | Sensibil. | " | " | " | " | " | | | |
| 34 | BF | Gain | 20 x 30 | 10 x 3 | 20 x 30 | 10 x 3 | 10 x 10 | | 10 7' | TRES BON SIGAL |
| | | Sensibil. | " | " | " | " | " | | | |
| 35 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 36 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 1' | 2 gros "pets" sur les Tellu |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Ciel bleu - Vent léger. |

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 22.10.82 | 404 25.11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

17845

Sketch :

N

Station : 7

Tape : 4

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 10kΩ | 275gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 10kΩ | 175gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 59 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 50x100 | | 7' |
| | | Sensibil. | 1 | 50mV/f | 1 | 50mV/f | 50mV/f | | |
| 60 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 50x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 61 | BF | Gain | 50x30 | 10x3 | 50x30 | 20x3 | 10x3 | | 72' |
| | | Sensibil. | " | " | " | " | " | | |
| 62 | BF | Gain | 20x30 | 10x3 | 20x30 | 20x3 | 10x3 | | 75' |
| | | Sensibil. | " | " | " | " | " | | |
| 63 | MF | Gain | 50x100 | 50x30 | 50x100 | 50x30 | 50x100 | | 1 |
| | | Sensibil. | " | " | " | " | " | | |
| 64 | HF | Gain | 50x100 | 50x30 | 50x100 | 50x30 | 50x100 | | 1 |
| | | Sensibil. | | | | | | | |

Remarks :

⊗

TRES BON SIGNAL - DERIVE SUR Passage d'un camion pendant TRAITER les 1: 35mn, laissez les et " les dernières 35mn

BON SIGNAL (Ne pas Traiter 3 les 2 35mn)

Très bruité

BROUILLARD - PLUIE et VENT par intermittence

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 15-10-88 | 404 25 11 | | UNION |

# MAGNETOTELLURIC REPORT

Processing :

Sketch :

Station : 8

Tape : 1

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 8 kΩ | 125° | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 500' | 10 kΩ | | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 50x30 | | 7' | "Pets" → LP 100Hz ON |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | | |
| 13 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 50x30 | | 1' | LP 100Hz OFF |
| | | Sensibil. | " | " | " | " | " | | | |
| 14 | BF | Gain | 50x30 | 20x1 | 50x30 | 20x1 | 10x3 | | 107' | LP 100Hz ON |
| | | Sensibil. | " | " | " | " | " | | | |
| 15 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 50x30 | | 7' | LP 100Hz OFF |
| | | Sensibil. | " | " | " | " | " | | | |
| 16 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 50x30 | | 1' | LP 100Hz OFF |
| | | Sensibil. | " | " | " | " | " | | | ST très bonne entre les orage en MF. |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | |

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RADULT | 17-10-82 | 404.25.11 | GLASS MT | UNION |

# MAGNETOTELLURIC REPORT

Station : 9

Tape : 2

Processing :

Sketch :

• Ey = 445'

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | EX | Hy | Ey | HX | HZ | | 500' | 19 kΩ | 130 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 445' | 20 kΩ | 30 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 22 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 7' | Quelques "pets" d'orage. ⊗ |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | | | |
| 23 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| *64 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 50 x 1 | | 107' | Beaucoup de "pets" d'orage sur Ey - Un peu moins sur les 3 |
| | | Sensibil. | " | " | " | " | " | | | |
| 25 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 7' | Quelques "pets" d'orage aussi. |
| | | Sensibil. | " | " | " | " | " | | | |
| 26 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 1' | * ATTENTION : Problème au du Fichier BF. J'ai écrit 64 la lecture on trouve 64 (* |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Ciel bleu - Vent leger |

⊗ En face des MF qui me semble les meilleures. Si pas trop mauvais au traitement, traiter les autres MF et Cha

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 17.10.82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURE REPORT

Station : 10

Tape : 2

Processing :

Sketch :

N

• Ey = 480'

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | EX | Hy | Ey | HX | Hz | | 152 500' | 14 kΩ | 330 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | • 146 480' | 17 kΩ | 230 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | MF | Gain | 10 x 300 | 20 x 30 | 10 x 300 | 20 x 30 | 50 x 30 | | 7' | BON SIGNAL ⊗ |
| | | Sensibil. | 1 | 50 mV/γ | 1 | 50 mV/γ | 50 mV/γ | | | |
| 28 | HF | Gain | 10 x 300 | 20 x 30 | 10 x 300 | 20 x 30 | 50 x 30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 29 | BF | Gain | 10 x 100 | 10 x 3 | 10 x 100 | 10 x 3 | 10 x 3 | | 107' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | |
| 30 | MF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 50 x 30 | | 7' | PROBLEME SUR Hz (pot Regulier Leger bruit sur Hy (vent leger bouger les arbres, qui font le sol qui fait bouger le Mag. |
| | | Sensibil. | " | " | " | " | " | | | |
| 31 | HF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 50 x 30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Ciel bleu - Vent léger |

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 15-10-82 | 404 25 11 | | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

Station : 11 Repris

Tape : 1

| | 0 | 1 | 2 | 3 | 4 | 5 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
| Sensor | Ex | Hy | Ey | Hx | Hz | Ex | 500' (152 m) | 20 kΩ | 25 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 500' | 20 kΩ | 325 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 (T1) | Channel 2 | Channel 3 (T2) | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 7 | MF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 20 x 30 | 20 x 300 | 7' |
| | | Sensibil. | 1 | 50mV/8 | 1 | 50mV/8 | 50mV/8 | 1 | |
| 8 | HF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 20 x 30 | 20 x 300 | 1' |
| | | Sensibil. | " | " | " | " | " | " | |
| 9 | BF | Gain | 20 x 100 | 10 x 3 | 20 x 100 | 10 x 3 | 10 x 3 | 20 x 100 | 107' |
| | | Sensibil. | " | " | " | " | " | " | |
| 10 | MF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 20 x 30 | 20 x 300 | 7' |
| | | Sensibil. | " | " | " | " | " | " | |
| 11 | HF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 20 x 30 | 20 x 300 | 1' |
| | | Sensibil. | " | " | " | " | " | " | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

En Voie 6 : Ex par
a Ex Voie 1, mais av
electrodes salées
R Ex Voie 6 = 12 kΩ

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 14.10.82 | 404.25.11 | | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

Station : 11

Tape : 1

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 152m | 40 kΩ | ~~25gr~~ | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 150m | 40kΩ | 325gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 4 | MF | Gain | 50x300 | 20x30 | 50x300 | 20x30 | 20x30 | | 7' |
| | | Sensibil. | 1 | 50mV/8 | 1 | 50mV/8 | 50mV/8 | | |
| 5 | HF | Gain | 50x300 | 20x30 | 50x300 | 20x30 | 20x30 | | 11' |
| | | Sensibil. | " | " | " | " | " | | |
| 6 | BF | Gain | 50x30 | 20x3 | 50x30 | 20x3 | 20x3 | | 35' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Résistances de prise de terre élevées. Signal Tellurique bruité.

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 16.10.82 | 404 25 11 | GLASS MT | UNION |

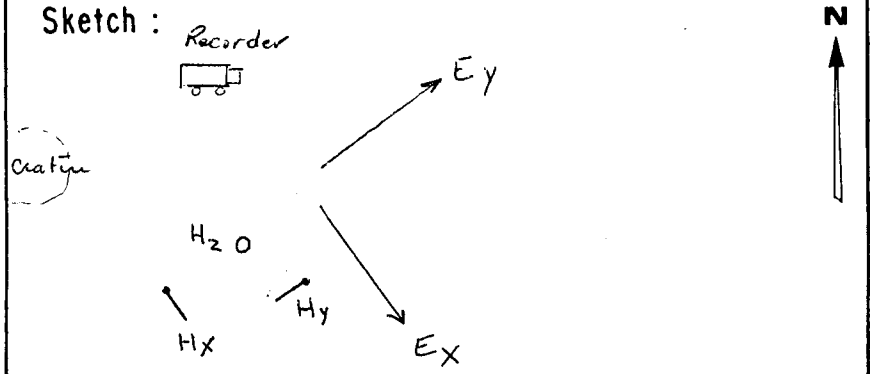
# MAGNETOTELLUR REPORT

Station : 12

Tape : 1

Processing :

Sketch :




| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 20 kΩ | 160 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 500' | 20 kΩ | 60 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 ($T_1$) | Channel 2 | Channel 3 ($T_2$) | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 7' | |
| | | Sensibil. | 1 | 50 mV/δ | 1 | 50 mV/δ | 50 mV/δ | | | |
| 18 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 1' | |
| | | Sensibil. | i | i | i | i | i | | | |
| 19 | BF | Gain | 20 x 30 | 20 x 1 | 20 x 30 | 20 x 1 | 50 x 1 | | 107' | Pets d'orage (1 par mn environ |
| | | Sensibil. | | | | | | | | |
| 20 | MF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 50 x 30 | | 7' | |
| | | Sensibil. | i | i | i | i | i | | | |
| 21 | HF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 50 x 30 | | 1' | |
| | | Sensibil. | i | i | i | i | i | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | |

E.N.D.T. FIN de BANDE 1

| | | | | |
|---|---|---|---|---|
| ... | ... 10 82 | 404 25 11 | GLASS MT | CLIENT : UNION |

# MAGNETOTE REPO

Station : 13

Tape : 3

Processing :

Sketch :

N

• Ey = 450'

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 9kΩ | 240gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 450' | 15kΩ | 140gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 42 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 20 x 100 | | 7' | - perturbation sur Ex |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | | |
| 43 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 20 x 100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 44 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 20 x 3 | 10 x 3 | | 107' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | |
| 45 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 20 x 100 | | 7' | MF.HF : O.K. ⊗ |
| | | Sensibil. | " | " | " | " | " | | | |
| 46 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 20 x 100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | ciel couvert - pas de Vo |

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 19-10-92 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURIC REPORT

Processing :

Sketch :

N

- Sur Ey : Denivelé de ≃ +25 m entre le centre et electrode lointaine
- Hz = Mag CM10/16

Station : 14

Tape : 2

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 9kΩ | 10gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 9kΩ | 310gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 37 | MF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 7' | ⊗ |
| | | Sensibil. | 1 | 50mV/8 | 1 | 50mV/8 | 50mV/8 | | | |
| 38 | HF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 39 | BF | Gain | 20x30 | 5x3 | 20x30 | 10x3 | 10x3 | | 107' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | |
| 40 | MF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 7' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 41 | HF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 1'40" | |
| | | Sensibil. | " | " | " | " | " | | 2' | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Ciel couvert - Pas de Vent |

E.N.D.T FIN de BANDE 2

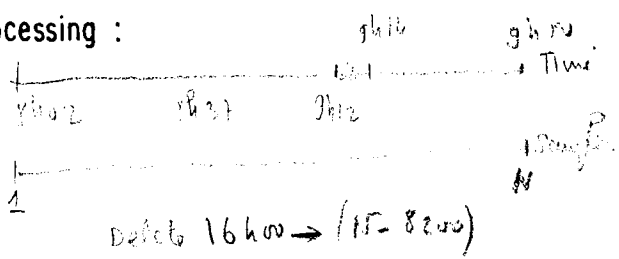
| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 29-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

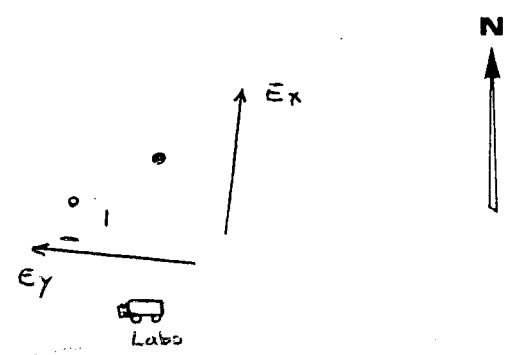
Station : 15

Tape : 5

Processing :




Sketch :




| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | | | | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | | | | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' | |
| | | Sensibil. | 1 | 50mV/V | 1 | 50mV/V | 1 x 50 | PA | | |
| 18 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 19 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 10 x 3 | | 108' | BON SIGNAL \| Ne pas TRAITER qui suivent l. |
| | | Sensibil. | " | " | " | " | " | | | |
| 20 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' | |
| | | Sensibil. | | | | | | | | ⊗ |
| 21 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 1' | |
| | | Sensibil. | | | | | | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Neige et Vent. |

E.N.D.T FIN de BANDE 5.

• Forage pour Eau a 100m

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RADULT | 20-10-82 | 404 25 11 | GLASS MT. | UNION |

# MAGNETOTELLUR REPORT

Station : 16

Tape : 3

Processing :

Sketch :

• Ex = 485'

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 485' | 5kΩ | 140 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 9kΩ | 40 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| L17 | MF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 7' | ⊗ |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | | |
| L18 | HF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| L19 | BF | Gain | 20x30 | 10x3 | 20x30 | 10x3 | 10x3 | | 107' | Bon SIGNAL - Mais beaucoup de Petits "pets" à partir du milieu des BF |
| | | Sensibil. | " | " | " | " | " | | | |
| L50 | MF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 7' | |
| | | Sensibil. | " | " | " | " | " | | | |
| L51 | HF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | ciel couvert - pluie fine |

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 20-10-82 | 404.25.11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

+

- 800mV crête/crête de 60Hz à l'entrée de Ex
- 1800mV " " " de Ey
⇒ Gains plus faibles

Station : 17

Tape : 3

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 7kΩ | 300gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 480' | 8kΩ | 200gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 52 | MF | Gain | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 7' | |
| | | Sensibil. | 1 | 50mV/F | 1 | 50mV/F | 50mV/F | | | |
| 53 | HF | Gain | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 54 | BF | Gain | 10x30 | 10x3 | 5x30 | 10x3 | 10x3 | | 107' | Signal Moyen |
| | | Sensibil. | " | " | " | " | " | | | |
| 55 | MF | Gain | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 7' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 56 | HF | Gain | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 57 | BF | Gain | 10x30 | 10x3 | 5x30 | 10x3 | 10x3 | | 70' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | Ciel couvert |
| 58 | MF | | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 7' | ⊕ |

UNION OIL COMPANY OF CALIFORNIA

UNION GEOTHERMAL DIVISION

# Magnetotelluric Survey

# Glass Mountain Project

October 1982

## NUMERICAL RESULTS

*** STATION A1 ***

DOMAINE BF

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .06594 | 169.01 | 50.24 | 26. | 37. | 155. | .64 | .96 | .272 | .177 | 13. | 11.41 | 7.55 | 134. | -39. |
| .10156 | 136.97 | 54.68 | 26. | 35. | -19. | .98 | .93 | .184 | .549 | 98. | 8.15 | 3.51 | . | -43. |
| .12500 | 174.16 | 43.33 | 23. | 47. | -11. | .88 | .97 | .186 | .725 | 70. | 6.88 | 3.41 | 10. | 135. |
| .14544 | 136.44 | 35.63 | 21. | 43. | -12. | .75 | .86 | .243 | .858 | 59. | 6.95 | 7.25 | -. | 126. |
| .17969 | 76.50 | 28.29 | 15. | 97. | -0. | .27 | .55 | .852 | .643 | 19. | 6.02 | 21.84 | -24. | -42. |
| .21094 | 44.08 | 20.25 | 7. | 13. | -14. | .17 | .33 | 1.819 | .358 | 26. | 4.15 | 20.46 | -40. | -24. |
| .25000 | 37.62 | 12.82 | 6. | 40. | -12. | .14 | .35 | 9.562 | .421 | 47. | 10.33 | 30.81 | 134. | -39. |
| .29687 | 34.49 | 22.38 | -3. | -293. | -10. | .03 | .20 | 3.474 | .516 | 47. | 4.78 | 20.09 | 127. | -43. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 390.70 | 64.05 | 51. | 42. | -4. | .83 | .98 | .135 | .691 | -16. | 29.63 | .16 | 94. | 28. |
| .02539 | 406.51 | 75.41 | 46. | 44. | -7. | 1.00 | .99 | .098 | .652 | 87. | 19.13 | 2.80 | 68. | 46. |
| .03125 | 368.13 | 71.16 | 42. | 46. | -7. | 1.00 | 1.00 | .089 | .643 | 86. | 18.33 | 1.46 | 63. | 57. |
| .03711 | 389.96 | 71.32 | 40. | 43. | -6. | 1.00 | 1.00 | .110 | .653 | 98. | 19.93 | 2.65 | 58. | 47. |
| .04492 | 362.96 | 66.71 | 34. | 41. | -7. | .99 | .99 | .103 | .631 | 56. | 18.04 | 1.65 | 54. | 50. |
| .05273 | 335.45 | 67.00 | 32. | 39. | -9. | 1.00 | .99 | .094 | .554 | 57. | 13.32 | 1.04 | 50. | 49. |
| .06250 | 285.95 | 69.00 | 28. | 36. | 154. | .99 | 1.00 | .185 | .229 | 61. | 10.48 | 4.58 | -45. | -32. |
| .07422 | 261.64 | 65.63 | 25. | 36. | -13. | .98 | 1.00 | .116 | .505 | 78. | 9.66 | .06 | 25. | 12. |
| .08984 | 239.80 | 52.50 | 23. | 36. | -9. | .99 | .99 | .080 | .586 | 70. | 8.95 | .23 | 38. | 51. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 161.49 | 36.27 | 43. | 100. | 151. | .68 | .92 | .486 | .239 | 155. | 24.78 | 19.23 | -40. | 132. |
| .00635 | 191.84 | 26.89 | 58. | 51. | -23. | .60 | .96 | .265 | .118 | -15. | 5.83 | 7.41 | -17. | -28. |
| .00781 | 325.09 | 41.40 | 60. | 65. | -6. | .44 | .83 | .170 | .727 | 151. | 26.96 | 12.85 | 80. | 46. |
| .00928 | 316.01 | 55.88 | 59. | 60. | -5. | .92 | .97 | .084 | .734 | 149. | 16.01 | 5.02 | 80. | 43. |
| .01123 | 287.43 | 53.76 | 54. | 55. | -9. | .89 | .98 | .108 | .515 | 52. | 12.05 | 2.03 | 70. | 61. |
| .01318 | 315.30 | 55.15 | 53. | 53. | -12. | .91 | .98 | .101 | .422 | 35. | 10.17 | 1.41 | 66. | 57. |
| .01562 | 296.85 | 63.96 | 53. | 55. | -13. | .91 | .99 | .114 | .479 | 75. | 11.60 | 2.75 | 73. | 58. |
| .01855 | 364.17 | 65.36 | 49. | 52. | -10. | .97 | .99 | .067 | .486 | 57. | 10.69 | .93 | 66. | 55. |
| .02246 | 392.63 | 70.29 | 48. | 52. | -9. | .96 | 1.00 | .083 | .515 | 53. | 13.07 | 1.67 | 63. | 50. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 58.85 | 32.44 | 25. | 65. | 6. | .41 | .85 | .471 | 1.300 | 48. | 1.45 | 8.23 | -28. | -43. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .81250 | 76.64 | 44.98 | 33. | 82. | -5. | .30 | .30 | .522 | .505 | 24. | 4.76 | 12.16 | -37. | -34. |
| .93750 | 67.16 | 47.72 | 25. | 71. | 16. | .45 | .54 | .639 | 3.073 | 25. | 9.83 | 25.77 | -13. | -32. |
| 1.18750 | 76.57 | 44.21 | 36. | 43. | 4. | .33 | .39 | .497 | 1.314 | 16. | 8.84 | 14.65 | -25. | -28. |
| 1.43750 | 60.50 | 36.54 | 47. | 52. | 156. | .55 | .76 | .322 | 1.700 | 34. | 4.35 | 14.60 | -14. | 127. |
| 1.68750 | 68.63 | 30.24 | 36. | 72. | -2. | .64 | .77 | .473 | .762 | -1. | 3.15 | 9.43 | -23. | -29. |
| 2.00000 | 47.96 | 26.39 | 39. | 53. | 9. | .42 | .25 | .331 | 1.329 | 36. | 1.54 | 3.96 | -22. | -26. |
| 2.37500 | 77.45 | 24.93 | 42. | 54. | 6. | .54 | .80 | .469 | 1.256 | 20. | 2.72 | 10.76 | -16. | -17. |
| 2.87500 | 63.24 | 24.54 | 42. | 56. | 12. | .36 | .49 | .523 | 2.114 | 39. | 2.62 | 10.61 | -27. | -26. |
| 3.37500 | 45.94 | 29.55 | 49. | 56. | -1. | .65 | .53 | .200 | .639 | 43. | 1.54 | 2.91 | -26. | -17. |
| 4.00000 | 54.89 | 42.66 | 47. | 67. | 8. | .58 | .79 | .301 | 2.123 | 43. | 2.23 | 4.46 | -13. | -32. |
| 4.81250 | 51.33 | 40.66 | 54. | 59. | 146. | .72 | .80 | .169 | .635 | 43. | 1.57 | 1.81 | -19. | -36. |
| 5.75000 | 54.14 | 45.17 | 58. | 58. | 143. | .88 | .91 | .159 | 1.245 | 56. | 1.36 | 1.94 | -18. | -38. |
| 6.81250 | 57.81 | 48.99 | 55. | 62. | -10. | .99 | 1.00 | .192 | 1.459 | 72. | 1.24 | 2.56 | -22. | -37. |
| 8.06250 | 57.33 | 48.32 | 60. | 61. | 135. | .99 | .99 | .109 | .926 | 74. | 1.02 | .66 | -20. | -25. |
| 9.62500 | 64.33 | 49.25 | 60. | 64. | 124. | .93 | .54 | .110 | 1.449 | 74. | 1.74 | .83 | -24. | -31. |
| 11.5000 | 65.46 | 59.53 | 69. | 64. | 104. | .82 | .91 | .132 | .528 | 70. | 1.51 | 1.36 | -18. | -26. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 156.91 | 35.59 | 14. | 5. | -5. | .08 | .31 | 1.316 | .649 | 64. | 4.87 | 60.92 | -19. | -21. |
| .35937 | 69.48 | 25.83 | 18. | 8. | -17. | .24 | .28 | 1.456 | .690 | 72. | 8.50 | 76.66 | 134. | -4. |
| .42187 | 159.61 | 39.59 | -2. | 36. | -20. | .10 | .47 | 1.128 | .291 | 23. | 7.19 | 26.31 | -31. | 111. |
| .50000 | 95.21 | 65.24 | -5. | 108. | -3. | .31 | .42 | 1.012 | 1.224 | 52. | 10.90 | 50.75 | -15. | 120. |
| .59375 | 114.75 | 21.38 | 21. | 109. | -10. | .36 | .35 | .799 | .479 | 40. | 3.75 | 47.11 | -16. | -6. |
| .71875 | 63.19 | 38.01 | 28. | 94. | -28. | .12 | .16 | .628 | .159 | 45. | 10.74 | 13.39 | -32. | -38. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 75.57 | 59.30 | 66. | 62. | 133. | .98 | .95 | .209 | 1.697 | 17. | 3.45 | 4.12 | -19. | -35. |
| 14.0000 | 75.72 | 70.31 | 64. | 69. | 141. | .98 | .95 | .131 | 1.041 | 28. | 1.71 | 1.20 | -27. | -20. |
| 17.0000 | 83.18 | 75.11 | 66. | 69. | 131. | .99 | .95 | .140 | .419 | 25. | 1.88 | 2.30 | -22. | -34. |
| 20.0000 | 88.36 | 85.45 | 67. | 71. | 143. | .99 | .99 | .118 | .315 | 15. | 1.35 | 1.25 | -18. | -18. |
| 24.0000 | 94.84 | 90.20 | 71. | 69. | 96. | .99 | .99 | .108 | 1.368 | 36. | 1.26 | 1.11 | -12. | -18. |
| 29.0000 | 136.87 | 56.25 | 73. | 65. | 29. | .77 | .63 | .200 | 4.075 | 41. | 3.11 | 2.80 | 119. | -29. |
| 35.0000 | 115.83 | 108.91 | 74. | 71. | 75. | .98 | .96 | .105 | .230 | 32. | 1.33 | 1.29 | -14. | -15. |
| 41.0000 | 133.98 | 123.34 | 74. | 73. | 94. | .98 | .89 | .117 | .727 | 33. | 2.47 | 2.31 | -22. | -27. |
| 49.0000 | 147.84 | 125.04 | 77. | 75. | 74. | .98 | .95 | .101 | .138 | 20. | 1.61 | 1.52 | -17. | -21. |
| 58.0000 | 244.01 | 12.05 | 76. | 40. | 65. | .89 | .68 | .528 | .246 | 66. | 35.70 | 28.44 | 96. | 97. |
| 70.0000 | 233.24 | 62.22 | 75. | 68. | 66. | .97 | .72 | .178 | .189 | 43. | 7.17 | 7.17 | 116. | 116. |
| 83.0000 | 213.30 | 160.03 | 76. | 75. | 52. | .94 | .88 | .131 | .623 | 29. | 1.65 | 2.91 | -24. | -17. |
| 98.0000 | 226.96 | 169.41 | 73. | 75. | 54. | .91 | .88 | .133 | .482 | 23. | 2.11 | 3.06 | -29. | -21. |
| 117.000 | 233.46 | 120.66 | 80. | 72. | 46. | .84 | .77 | .175 | .856 | 29. | 5.65 | 3.93 | 125. | -35. |

*** STATION A2 ***

DOMAINE MF

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 130.11 | 37.22 | 37. | 134. | 32. | .27 | .06 | 1.496 | .532 | 319. | 123.94 | 147.09 | -40. | 125. |
| .81250 | 1506.98 | 332.23 | 12. | -312. | 43. | .37 | .18 | 2.155 | .779 | 306. | 1736.33 | 435.48 | 114. | -27. |
| .93750 | 478.31 | 84.17 | -2. | 37. | 36. | .35 | .24 | 1.953 | .510 | 319. | 376.75 | 173.18 | -44. | 126. |
| 1.18750 | 704.85 | 57.25 | 98. | 69. | 252. | .51 | .38 | .802 | 1.060 | 319. | 359.63 | 47.95 | 135. | -24. |
| 1.43750 | 367.53 | 19.37 | 37. | 49. | 26. | .27 | .14 | .854 | .940 | 311. | 245.08 | 140.96 | -20. | -42. |
| 1.68750 | 538.12 | 60.23 | -14. | 131. | 37. | .20 | .15 | 1.876 | .432 | 317. | 459.76 | 232.97 | 133. | 134. |
| 2.00000 | 123.49 | 16.46 | 12. | 58. | 46. | .18 | .15 | .621 | .149 | 319. | 19.67 | 21.53 | 127. | 119. |
| 2.37500 | 207.34 | 37.87 | 67. | 117. | 46. | .05 | .08 | .997 | .939 | 317. | 198.80 | 29.57 | 116. | 99. |
| 2.87500 | 444.30 | 65.01 | 43. | 3. | 36. | .09 | .08 | 1.201 | .438 | 315. | 331.24 | 171.11 | -37. | -37. |
| 3.37500 | 264.45 | 57.59 | -9. | 51. | 37. | .18 | .12 | .801 | .856 | 317. | 176.10 | 49.34 | 108. | 124. |
| 4.00000 | 245.09 | 57.01 | 29. | 22. | 30. | .14 | .13 | 1.418 | .699 | 316. | 213.65 | 102.29 | -40. | 129. |
| 4.81250 | 208.91 | 98.94 | 29. | 76. | 13. | .39 | .16 | .827 | 3.374 | 325. | 202.15 | 79.89 | 127. | 127. |
| 5.75000 | 81.70 | 46.26 | 68. | 51. | 247. | .16 | .06 | .581 | 2.009 | 324. | 42.33 | 9.74 | 117. | 117. |
| 6.81250 | 61.18 | 22.14 | 61. | 66. | 41. | .33 | .12 | .396 | .770 | 316. | 12.37 | 2.07 | 120. | 111. |
| 8.06250 | 55.27 | 21.85 | 62. | 68. | 252. | .33 | .42 | .303 | 1.133 | 325. | 7.59 | 3.60 | 79. | 89. |
| 9.62500 | 82.75 | 26.45 | 66. | 67. | 238. | .80 | .29 | .306 | .371 | 319. | 7.26 | 5.34 | 82. | 92. |
| 11.5000 | 77.41 | 25.92 | 62. | 62. | 242. | .37 | .16 | .446 | .517 | 317. | 14.63 | 10.13 | 81. | 88. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 101.69 | 85.37 | 11. | 51. | 282. | .52 | .30 | .789 | 7.098 | 317. | 39.87 | 51.89 | -27. | -37. |
| .35937 | 122.01 | 37.79 | -176. | 17. | 296. | .17 | .12 | 1.079 | .700 | 320. | 68.32 | 10.87 | 122. | 107. |
| .42187 | 216.16 | 90.23 | -57. | 131. | 47. | .90 | .37 | 1.761 | .453 | 319. | 155.55 | 95.67 | -28. | -4. |
| .50000 | 46.78 | 24.36 | 134. | -203. | 312. | .17 | .02 | 4.917 | .236 | 320. | 46.84 | 41.84 | -39. | -33. |
| .59375 | 143.64 | 120.69 | -20. | 65. | 276. | .16 | .04 | .729 | 6.309 | 319. | 165.64 | 46.53 | 8. | -10. |
| .71875 | 149.42 | 32.68 | -11. | 69. | 230. | .19 | .21 | .890 | 1.160 | 320. | 116.17 | 64.31 | -22. | 110. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 196.45 | 40.57 | 67. | 67. | 236. | .95 | .86 | .555 | .375 | 290. | 46.80 | 22.23 | 109. | 109. |
| 14.0000 | 69.97 | 40.36 | 77. | 62. | 246. | .98 | .63 | .371 | 1.591 | 302. | 13.91 | 4.20 | 113. | 106. |
| 17.0000 | 75.98 | 42.87 | 71. | 76. | 43. | .95 | .67 | .322 | .842 | 275. | 10.13 | 2.95 | 116. | 102. |
| 20.0000 | 73.99 | 39.92 | 61. | 77. | 22. | .88 | .83 | .338 | 1.057 | 275. | 12.16 | 3.94 | 124. | 112. |
| 24.0000 | 77.05 | 42.80 | 70. | 72. | 356. | .98 | .71 | .233 | 4.015 | 275. | 5.84 | 2.74 | -35. | 134. |
| 29.0000 | 100.13 | 4.06 | 73. | 74. | 330. | .81 | .44 | .543 | .515 | 309. | 23.54 | 11.69 | -3. | -. |
| 35.0000 | 87.97 | 58.21 | 67. | 79. | 355. | .93 | .75 | .193 | 4.072 | 285. | 6.91 | 3.81 | 132. | 122. |
| 41.0000 | 135.63 | 77.34 | 65. | 74. | 44. | 1.00 | 1.00 | .192 | .536 | 293. | 5.63 | 2.69 | 106. | 87. |
| 49.0000 | 144.44 | 87.73 | 57. | 80. | 34. | .97 | .71 | .265 | 1.362 | 300. | 22.96 | 2.30 | 118. | 98. |
| 58.0000 | 210.82 | 7.57 | 75. | -205. | 344. | .74 | .40 | .920 | 1.141 | 321. | 148.23 | 37.22 | -9. | -17. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79.6606 | 176.29 | 12.32 | 74. | 46. | 344. | .98 | .29 | .337 | 1.134 | 325. | 45.01 | 7.08 | -4. | -7. |
| 83.6630 | 200.67 | 68.55 | 73. | 69. | 350. | 1.00 | .74 | .155 | 1.762 | 342. | 16.92 | 2.23 | -10. | -10. |
| 98.0000 | 208.74 | 150.17 | 67. | 80. | 26. | .98 | .78 | .147 | 1.623 | 310. | 5.98 | 2.75 | 118. | 78. |
| 117.000 | 215.79 | 127.87 | 87. | 66. | 313. | .58 | .64 | .305 | .834 | 313. | 16.63 | 18.27 | -18. | -14. |

DOMAINE BF

DECOUPAGE EN 46

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .06574 | 208.14 | 20.33 | 54. | 44. | 290. | .65 | .42 | .411 | 1.598 | 314. | 36.39 | 13.04 | 93. | 115. |
| .10156 | 136.79 | 33.97 | 29. | 43. | 300. | .84 | .44 | .486 | .716 | 318. | 23.74 | 29.04 | 96. | 107. |
| .12230 | 165.35 | 49.01 | 56. | 30. | 280. | .82 | .54 | .572 | 1.236 | 317. | 50.45 | 10.70 | 104. | 119. |
| .14644 | 139.65 | 26.50 | 80. | 12. | 286. | .48 | .12 | .648 | .978 | 318. | 34.98 | 3.68 | 115. | -20. |
| .17969 | 145.78 | 92.13 | 9. | 19. | 280. | .34 | .15 | 3.172 | .058 | 316. | 53.59 | 81.94 | 121. | 124. |
| .21094 | 119.27 | 64.34 | 4. | 41. | 282. | .20 | .08 | 5.459 | .116 | 306. | 58.82 | 77.19 | -41. | -42. |
| .25000 | 100.14 | 66.11 | -1. | 35. | 280. | .19 | .15 | 3.082 | .071 | 310. | 65.16 | 74.11 | 135. | 131. |
| .29687 | 80.74 | 44.91 | 19. | 18. | 281. | .20 | .08 | 2.100 | .229 | 314. | 38.82 | 54.06 | -37. | 131. |

DECOUPAGE EN 17

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 360.95 | 64.81 | 58. | 18. | 294. | .89 | .81 | .481 | 1.255 | 317. | 97.85 | 41.06 | 102. | 117. |
| .02539 | 269.84 | 33.30 | 61. | 83. | 292. | .84 | .69 | .339 | 1.372 | 308. | 70.34 | 20.60 | 68. | 57. |
| .03125 | 257.43 | 66.81 | 53. | 28. | 295. | .96 | .76 | .630 | 1.559 | 318. | 124.98 | 97.54 | 107. | 115. |
| .03711 | 260.75 | 21.52 | 34. | 33. | 301. | .85 | .33 | .329 | .765 | 318. | 45.48 | 20.04 | 78. | 91. |
| .04492 | 226.84 | 37.97 | 30. | 56. | 300. | .83 | .59 | .320 | .674 | 316. | 32.56 | 21.60 | 76. | 93. |
| .05273 | 181.42 | 35.36 | 39. | 1. | 302. | .73 | .18 | .301 | 1.269 | 316. | 47.79 | 39.41 | 102. | 112. |
| .06250 | 152.44 | 31.17 | 23. | 67. | 322. | .45 | .20 | .423 | .530 | 315. | 31.78 | 27.46 | 119. | 117. |
| .07422 | 241.46 | 21.90 | 22. | 50. | 295. | .63 | .26 | .186 | 1.014 | 318. | 29.81 | 3.80 | 55. | 70. |
| .08984 | 165.71 | 24.98 | 44. | 44. | 296. | .98 | .34 | .267 | 1.052 | 319. | 25.16 | 6.12 | 75. | 84. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 166.95 | 65.82 | 64. | -307. | 14. | .75 | .39 | 1.279 | 1.744 | 14. | 221.05 | 90.38 | -31. | 134. |
| .00635 | 22.33 | 16.16 | 5. | 31. | 259. | .19 | .40 | 11.980 | .833 | 305. | 128.00 | 43.07 | 82. | 87. |
| .00781 | 148.02 | 35.55 | 123. | 80. | 325. | .65 | .31 | .379 | 1.474 | 45. | 73.82 | 69.99 | 62. | 65. |
| .00925 | 202.29 | 22.91 | 51. | 57. | 340. | .92 | .30 | .671 | .918 | 256. | 90.80 | 40.79 | -38. | -44. |
| .01123 | 165.23 | 2.70 | 48. | 47. | 284. | .97 | .27 | 1.269 | 2.546 | 332. | 191.25 | 97.50 | 82. | 91. |
| .01318 | 224.46 | 16.37 | 48. | 68. | 297. | .97 | .40 | .755 | 1.115 | 315. | 135.91 | 62.93 | 57. | 52. |
| .01562 | 244.66 | 21.46 | 43. | 101. | 321. | .91 | .37 | .350 | .301 | 316. | 26.85 | 26.11 | 109. | 106. |
| .01855 | 304.59 | 22.23 | 46. | 58. | 296. | .95 | .40 | .320 | .976 | 323. | 66.27 | 21.46 | 77. | 92. |
| .02246 | 293.09 | 20.26 | 44. | 75. | 301. | .97 | .39 | .206 | .764 | 326. | 38.40 | 5.33 | 61. | 57. |

*** STATION B3 ***

DOMAINE BF

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .08594 | 517.45 | 190.59 | 18. | 126. | -59. | .26 | .59 | 1.322 | .166 | -46. | 205.91 | 260.32 | -40. | 131. |
| .10156 | 367.96 | 151.89 | 25. | 3. | 120. | .16 | .59 | 1.336 | .027 | -44. | 166.90 | 160.68 | -40. | -40. |
| .12500 | 1268.16 | 434.85 | -137. | 22. | 33. | .75 | .57 | 2.549 | .033 | -26. | 455.78 | 537.96 | 130. | 130. |
| .14844 | 343.07 | 230.61 | 4. | -305. | 120. | .17 | .50 | 9.105 | .240 | -38. | 304.86 | 314.46 | -38. | 129. |
| .17969 | 436.63 | 391.12 | 18. | -311. | -53. | .16 | .17 | 8.046 | .316 | -25. | 232.50 | 470.16 | -42. | -27. |
| .21094 | 327.01 | 307.51 | -153. | 22. | 33. | .09 | .11 | 3.045 | .069 | -14. | 287.04 | 325.58 | 126. | 126. |
| .25000 | 925.58 | 538.57 | 6. | -311. | -51. | .14 | .15 | 7.018 | .347 | -8. | 298.67 | 750.51 | -45. | 126. |
| .29687 | 1214.09 | 670.94 | 13. | 19. | -56. | .06 | .07 | 2.295 | .152 | 2. | 575.89 | 558.41 | 128. | -42. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 684.72 | 22.87 | 53. | 99. | 101. | .72 | .98 | .417 | .892 | -55. | 38.66 | 116.65 | -34. | 111. |
| .02539 | 694.82 | 52.75 | 43. | 48. | 107. | .27 | .94 | .259 | .537 | -52. | 59.75 | 30.11 | -31. | 128. |
| .03125 | 674.56 | 47.33 | 44. | 52. | 107. | .51 | .99 | .204 | .581 | -53. | 56.69 | 25.55 | -25. | 126. |
| .03711 | 701.27 | 59.93 | 41. | 58. | 102. | .64 | .95 | .145 | .792 | -55. | 52.40 | 16.26 | -26. | 122. |
| .04492 | 609.73 | 48.49 | 39. | 73. | 108. | .22 | .81 | .262 | .586 | -54. | 36.15 | 77.06 | -25. | 116. |
| .05273 | 506.75 | 80.92 | 20. | 132. | -58. | .25 | .75 | .678 | .255 | -50. | 29.04 | 87.93 | -39. | 119. |
| .06250 | 550.79 | 108.16 | 23. | 126. | -59. | .26 | .23 | .700 | .114 | -26. | 82.03 | 53.82 | 124. | 134. |
| .07422 | 460.49 | 98.92 | 26. | 24. | 120. | .25 | .61 | .614 | .264 | -46. | 21.89 | 63.24 | -26. | 118. |
| .08954 | 662.01 | 75.74 | 39. | 89. | 103. | .23 | .37 | .436 | .673 | -47. | 118.52 | 67.10 | -44. | 120. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 427.76 | 7.31 | 49. | 5. | 115. | .79 | .89 | .578 | .470 | -57. | 21.37 | 110.48 | -29. | 120. |
| .00635 | 731.45 | 16.73 | 57. | 50. | 116. | .47 | .85 | .423 | .350 | -56. | 48.21 | 93.44 | -19. | 134. |
| .00781 | 612.43 | 24.33 | 51. | 6. | 99. | .86 | .66 | .283 | 1.034 | -52. | 32.24 | 38.66 | -23. | 108. |
| .00928 | 599.34 | 22.77 | 61. | 64. | 104. | .65 | .96 | .023 | .657 | -57. | 26.94 | .14 | -18. | 42. |
| .01123 | 476.82 | 15.61 | 55. | 43. | 102. | .72 | .90 | .045 | .797 | -57. | 26.52 | .54 | -15. | 53. |
| .01318 | 451.49 | 23.82 | 57. | 42. | -55. | .50 | .90 | .485 | .152 | -57. | 26.23 | 40.38 | -15. | -10. |
| .01562 | 561.41 | 12.06 | 45. | 72. | 105. | .08 | .27 | .245 | .644 | -54. | 23.04 | 22.46 | -34. | 106. |
| .01855 | 556.15 | 26.99 | 55. | 51. | 100. | .34 | .93 | .143 | .504 | -56. | 36.66 | 4.90 | -20. | -36. |
| .02246 | 727.90 | 26.35 | 45. | 36. | 105. | .21 | .98 | .130 | .624 | -54. | 44.98 | 6.83 | -28. | 122. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .66750 | 342.09 | 256.26 | 36. | 23. | 113. | .12 | .79 | 1.653 | .272 | 16. | 294.06 | 194.12 | -40. | -44. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .81250 | 205.07 | 125.32 | -177. | 25. | 29. | .10 | .10 | 1.408 | .053 | -15. | 111.23 | 96.81 | -43. | -42. |
| .93750 | 170.43 | 37.55 | 93. | 34. | 55. | .23 | .62 | .589 | .621 | 12. | 50.82 | 100.16 | -30. | -45. |
| 1.16750 | 291.25 | 126.98 | 86. | 28. | 40. | .73 | .47 | .793 | .314 | 15. | 88.16 | 99.24 | -30. | -37. |
| 1.42750 | 156.67 | 56.74 | 64. | 32. | 54. | .26 | .40 | .464 | .790 | 13. | 31.07 | 28.82 | -29. | -44. |
| 1.68750 | 103.24 | 39.98 | 44. | 37. | 87. | .08 | .36 | .811 | .737 | 13. | 61.16 | 74.63 | -41. | 127. |
| 2.06250 | 109.67 | 24.55 | 46. | 50. | 90. | .06 | .48 | .502 | 1.082 | 10. | 31.09 | 25.51 | -28. | 133. |
| 2.37500 | 63.78 | 42.90 | 44. | 52. | 132. | .15 | .47 | .450 | .545 | -4. | 11.26 | 9.45 | -22. | -32. |
| 2.87500 | 77.37 | 21.82 | 44. | 55. | 73. | .20 | .09 | .748 | 5.536 | 12. | 49.41 | 27.49 | -36. | -41. |
| 3.37500 | 85.09 | 36.78 | 66. | 46. | 58. | .38 | .20 | .638 | .559 | 4. | 37.92 | 44.76 | -33. | -43. |
| 4.06250 | 87.43 | 31.90 | 53. | 42. | 96. | .40 | .54 | .440 | 1.441 | 19. | 22.27 | 13.00 | -15. | -32. |
| 4.81250 | 69.69 | 26.15 | 62. | 41. | 89. | .21 | .14 | .280 | 2.475 | 12. | 7.48 | 5.74 | -18. | 134. |
| 5.75000 | 59.63 | 35.62 | 59. | 51. | 85. | .28 | .49 | .195 | 1.542 | 26. | 3.28 | 4.01 | -19. | 134. |
| 6.81250 | 70.29 | 24.53 | 57. | 53. | 91. | .60 | .73 | .218 | 1.619 | 30. | 7.61 | 3.37 | -20. | -41. |
| 8.06250 | 62.47 | 22.27 | 62. | 53. | 86. | .80 | .93 | .213 | 2.417 | 29. | 12.24 | 2.99 | -12. | -31. |
| 9.62500 | 68.42 | 31.64 | 59. | 56. | 94. | .35 | .91 | .116 | 1.394 | 24. | 3.54 | .73 | -13. | -25. |
| 11.5000 | 90.61 | 26.34 | 61. | 66. | 92. | .12 | .22 | .237 | 1.178 | 24. | 9.78 | 7.28 | -24. | 133. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 888.30 | 71.70 | -42. | 41. | 60. | .31 | .55 | .365 | .928 | 23. | 185.38 | 246.81 | 131. | -20. |
| .35937 | 594.64 | 270.77 | 95. | 29. | 20. | .07 | .16 | .890 | .376 | 33. | 241.75 | 173.38 | -40. | -34. |
| .42187 | 694.30 | 46.73 | 93. | 68. | 71. | .07 | .33 | .514 | 1.500 | 16. | 235.91 | 205.59 | -13. | -36. |
| .50000 | 914.31 | 124.50 | 94. | 12. | 53. | .14 | .94 | .568 | .700 | 26. | 189.32 | 378.14 | -30. | 131. |
| .59375 | 261.06 | 158.09 | 96. | 19. | 23. | .19 | .40 | .517 | .531 | 26. | 71.04 | 63.71 | 131. | 135. |
| .71875 | 535.84 | 60.34 | 77. | 7. | 66. | .37 | .30 | .572 | 2.007 | 27. | 287.20 | 71.31 | -5. | -22. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 85.80 | 32.28 | 64. | 50. | 83. | .98 | .98 | .183 | 4.035 | -31. | 7.53 | 2.84 | -16. | -42. |
| 14.0000 | 89.26 | 30.72 | 61. | 59. | 91. | .98 | .99 | .134 | 1.725 | 1. | 6.03 | 1.35 | -15. | -31. |
| 17.0000 | 100.39 | 38.90 | 63. | 59. | 89. | .97 | 1.00 | .137 | 1.990 | -14. | 7.94 | 1.42 | -11. | -23. |
| 20.0000 | 104.80 | 42.26 | 62. | 62. | 88. | .97 | .99 | .135 | 2.101 | -9. | 7.86 | 1.48 | -16. | -24. |
| 24.0000 | 108.70 | 44.49 | 64. | 62. | 89. | .97 | .98 | .112 | 1.903 | -7. | 6.59 | 1.33 | -14. | -32. |
| 29.0000 | 171.03 | 37.52 | 67. | 62. | 72. | .34 | .93 | .101 | 6.894 | -39. | 13.12 | .70 | -15. | 128. |
| 35.0000 | 130.10 | 55.77 | 64. | 62. | 88. | .99 | .98 | .099 | 2.288 | -41. | 7.47 | .88 | -12. | -20. |
| 41.0000 | 138.34 | 62.32 | 64. | 64. | 89. | .97 | .99 | .100 | 2.053 | -30. | 7.45 | .90 | -10. | -16. |
| 49.0000 | 199.50 | 56.10 | 64. | 67. | 87. | .93 | .99 | .082 | 2.017 | -6. | 6.81 | .86 | -12. | -30. |
| 58.0000 | 222.57 | 39.14 | 45. | 50. | 27. | .91 | .70 | .508 | .673 | 23. | 59.40 | 54.39 | 92. | 94. |
| 70.0000 | 158.97 | 94.93 | 58. | 62. | 83. | .87 | .92 | .048 | 3.764 | -14. | 4.04 | .04 | -34. | -28. |
| 83.0000 | 180.95 | 82.15 | 63. | 54. | 89. | .51 | .96 | .136 | 1.889 | 3. | 10.95 | 2.17 | -16. | -27. |
| 98.0000 | 166.67 | 82.74 | 64. | 60. | 97. | .64 | .97 | .146 | 1.217 | 10. | 9.39 | 2.39 | -10. | -24. |
| 117.000 | 146.37 | 119.46 | 49. | 56. | 89. | .49 | .94 | .223 | 1.056 | 25. | 12.41 | 9.46 | -34. | -4. |

*** STATION A4 ***

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 540.87 | 366.55 | -164. | . | 35. | .30 | .35 | 3.435 | .732 | 56. | 62.33 | 342.30 | -38. | 133. |
| .81250 | 344.06 | 316.13 | 1. | 129. | 3. | .55 | .43 | 2.277 | .969 | 43. | 42.97 | 309.59 | 125. | 134. |
| .93750 | 212.27 | 156.41 | -167. | 6. | 90. | .26 | .23 | 2.686 | .958 | 65. | 11.51 | 149.24 | 129. | 128. |
| 1.06750 | 79.91 | 33.23 | 38. | 87. | 32. | .08 | .10 | 1.066 | 2.160 | 61. | 12.92 | 35.14 | -38. | -36. |
| 1.43750 | 143.96 | 65.53 | 11. | 102. | 14. | .32 | .21 | 1.289 | 2.161 | 57. | 6.35 | 73.73 | 119. | 127. |
| 1.68750 | 105.94 | 69.12 | 29. | 96. | 29. | .21 | .14 | .909 | 4.643 | 55. | 5.06 | 38.00 | -33. | -43. |
| 2.00000 | 76.20 | 29.32 | 29. | 69. | 26. | .26 | .08 | .787 | 1.934 | 63. | 4.84 | 16.27 | 119. | 135. |
| 2.37500 | 91.79 | 36.24 | 93. | 31. | 106. | .41 | .24 | .793 | 4.801 | 59. | 5.70 | 18.34 | -26. | 123. |
| 2.87500 | 82.46 | 14.05 | 48. | 91. | 29. | .26 | .09 | .740 | 2.241 | 52. | 1.33 | 13.48 | 128. | -28. |
| 3.37500 | 51.00 | 34.47 | 45. | 86. | 42. | .32 | .14 | .690 | 3.217 | 58. | 2.07 | 7.65 | -41. | -41. |
| 4.00000 | 75.32 | 21.49 | 69. | 49. | 95. | .28 | .13 | .463 | 1.619 | 60. | 2.10 | 4.79 | 131. | 104. |
| 4.81250 | 61.18 | 30.28 | 66. | 50. | 82. | .63 | .30 | .429 | 1.324 | 67. | 2.39 | 2.84 | 132. | 121. |
| 5.75000 | 69.62 | 23.27 | 66. | 57. | 81. | .86 | .56 | .251 | .595 | 71. | .53 | 1.79 | 110. | 95. |
| 6.81250 | 74.62 | 25.98 | 64. | 66. | 75. | .96 | .79 | .127 | .253 | 77. | .21 | .74 | 88. | 82. |
| 8.06250 | 61.64 | 20.25 | 64. | 66. | 72. | .99 | .96 | .108 | .169 | 78. | .23 | .54 | 81. | 79. |
| 9.62500 | 83.25 | 29.74 | 64. | 67. | 74. | .98 | .93 | .094 | .201 | 78. | .18 | .50 | 75. | 75. |
| 11.5000 | 92.50 | 34.55 | 66. | 66. | 76. | .95 | .73 | .133 | .289 | 75. | .42 | 1.13 | 102. | 91. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 3219.71 | 266.67 | 101. | -219. | 63. | .59 | .16 | 1.846 | .840 | 61. | 110.51 | 44.08 | 116. | 133. |
| .35937 | 645.16 | 352.10 | -128. | 61. | 92. | .28 | .35 | 1.740 | .954 | 65. | 111.52 | 437.45 | 8. | -14. |
| .42187 | 579.81 | 276.74 | -172. | 23. | 100. | .48 | .41 | .998 | 1.601 | 61. | 52.49 | 182.03 | 16. | -36. |
| .50000 | 86.15 | 22.54 | -84. | 113. | 106. | .07 | .12 | 2.053 | .866 | 69. | 43.55 | 192.74 | 30. | 16. |
| .59375 | 478.27 | 169.99 | -51. | 23. | 95. | .28 | .17 | 1.319 | 1.335 | 58. | 14.50 | 169.31 | 119. | -23. |
| .71875 | 93.39 | 14.52 | 36. | 93. | 27. | .23 | .14 | .949 | 1.844 | 61. | 4.81 | 34.58 | -13. | -19. |

DOMAINE MF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 97.61 | 34.37 | 67. | 66. | 79. | .99 | .99 | .181 | .401 | 55. | .60 | 1.90 | 104. | 91. |
| 14.0000 | 108.65 | 39.81 | 65. | 65. | 72. | .99 | .98 | .125 | .249 | 65. | .35 | .75 | 87. | 84. |
| 17.0000 | 117.95 | 42.52 | 65. | 66. | 74. | .99 | .99 | .122 | .219 | 59. | .35 | 1.03 | 91. | 85. |
| 20.5000 | 125.74 | 46.12 | 66. | 67. | 74. | .99 | .99 | .107 | .226 | 58. | .25 | .87 | 91. | 84. |
| 24.6000 | 131.07 | 48.77 | 65. | 66. | 77. | .99 | .98 | .118 | .315 | 65. | .23 | 1.25 | 95. | 85. |
| 29.6000 | 161.25 | 18.41 | 64. | 70. | 91. | .92 | .89 | .207 | 1.039 | 57. | 3.62 | 3.18 | -29. | 93. |
| 35.5000 | 154.49 | 60.00 | 66. | 67. | 76. | .99 | .99 | .161 | .303 | 68. | 1.61 | 3.37 | 106. | 95. |
| 41.0000 | 171.31 | 65.59 | 67. | 66. | 76. | .99 | .97 | .088 | .178 | 60. | .29 | .93 | 87. | 84. |
| 49.6000 | 181.72 | 64.35 | 68. | 64. | 73. | .98 | .96 | .102 | .191 | 63. | .50 | 1.38 | 90. | 87. |
| 59.0000 | 212.61 | 3.48 | 69. | 36. | 70. | .84 | .58 | .484 | .105 | 67. | 12.96 | 16.20 | 93. | 92. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70.0000 | 242.96 | 57.52 | 67. | 61. | 71. | .99 | .77 | .141 | .119 | 62. | 1.77 | 3.02 | 91. | 88. |
| 83.0000 | 255.95 | 73.10 | 66. | 62. | 81. | .96 | .87 | .212 | .516 | 58. | 3.04 | 9.28 | 108. | 96. |
| 98.0000 | 256.41 | 68.94 | 68. | 60. | 73. | .98 | .94 | .110 | .197 | 48. | .53 | 1.76 | 94. | 90. |
| 117.000 | 294.67 | 67.34 | 67. | 56. | 74. | .70 | .89 | .212 | .281 | 52. | 2.25 | 4.36 | 111. | 101. |

DOMAINE BF

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .08594 | 208.66 | 31.12 | 40. | 16. | 23. | .78 | .80 | .421 | 3.663 | 54. | 28.66 | 9.76 | 96. | 132. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .10156 | 126.26 | 36.05 | 36. | 13. | 27. | .75 | .46 | .532 | 2.050 | 51. | 21.92 | 11.23 | 104. | 130. |
| .12500 | 268.00 | 77.39 | 21. | 48. | -7. | .22 | .26 | .848 | .881 | 62. | 64.15 | 93.83 | -28. | -38. |
| .14844 | 327.71 | 64.78 | 10. | 104. | -14. | .31 | .17 | .910 | .310 | 68. | 40.78 | 73.47 | 125. | -40. |
| .17969 | 439.53 | 140.25 | -5. | 28. | -10. | .05 | .05 | 4.314 | .467 | 62. | 103.32 | 307.05 | -36. | -37. |
| .21094 | 823.36 | 258.53 | 14. | -365. | -14. | .07 | .02 | 2.766 | .359 | 61. | 99.99 | 353.34 | -41. | 130. |
| .25000 | 561.25 | 252.09 | 30. | 39. | -7. | .11 | .14 | 2.301 | .604 | 62. | 77.30 | 350.18 | 134. | -17. |
| .29687 | 411.95 | 186.34 | -4. | 10. | -13. | .05 | .06 | 2.450 | .360 | 63. | 67.08 | 186.13 | -39. | 134. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 363.40 | 43.61 | 47. | 40. | 21. | .82 | .53 | .154 | 0 | 80. | 48.28 | 3.74 | 62. | 28. |
| .02539 | 317.42 | 31.49 | 41. | 34. | 26. | .93 | .84 | .080 | 8.844 | 95. | 45.06 | 1.28 | 64. | 37. |
| .03125 | 293.54 | 37.45 | 36. | 51. | 26. | .97 | .92 | .054 | 8.301 | 112. | 38.50 | .56 | 61. | 49. |
| .03711 | 202.91 | 35.69 | 36. | 30. | 27. | .97 | .94 | .095 | 6.328 | 110. | 35.47 | 1.30 | 60. | 40. |
| .04492 | 277.24 | 25.62 | 36. | 36. | 24. | .99 | .86 | .082 | 6.179 | 95. | 40.11 | 3.26 | 55. | 23. |
| .05273 | 268.19 | 15.72 | 27. | 27. | 27. | .96 | .16 | .031 | 6.311 | 91. | 34.65 | .30 | 58. | -5. |
| .06250 | 233.85 | 21.16 | 31. | 9. | 24. | .73 | .42 | .199 | 0 | 83. | 34.83 | 3.29 | 75. | 109. |
| .07422 | 186.11 | 29.29 | 28. | 22. | 28. | .92 | .49 | .222 | 5.182 | 68. | 23.43 | 4.05 | 74. | 103. |
| .08984 | 163.37 | 33.17 | 26. | 16. | 24. | .87 | .58 | .113 | 4.425 | 32. | 17.09 | .33 | 68. | 67. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 743.88 | 467.83 | 101. | -300. | -7. | .74 | .67 | .936 | .793 | -16. | 131.57 | 356.40 | 115. | -42. |
| .00635 | 1172.50 | 476.05 | 45. | -195. | 132. | .69 | .68 | .515 | 1.421 | -3. | 522.95 | 111.41 | -18. | 132. |
| .00781 | 194.83 | 10.32 | 88. | 72. | -1. | .33 | .55 | .856 | .946 | 56. | 113.28 | 63.60 | 96. | 107. |
| .00928 | 169.51 | 25.48 | 70. | 73. | 28. | .51 | .59 | .048 | 5.557 | 71. | 17.07 | .27 | 82. | 108. |
| .01123 | 252.17 | 17.93 | 58. | 55. | 29. | .67 | .77 | .155 | 3.709 | 56. | 29.32 | 6.29 | 66. | 24. |
| .01318 | 272.14 | 34.55 | 50. | 56. | 30. | .92 | .81 | .023 | 4.277 | 76. | 24.57 | .03 | 69. | -37. |
| .01562 | 308.26 | 25.80 | 55. | 69. | 23. | .98 | .57 | .111 | 0 | 74. | 57.48 | 1.59 | 70. | 79. |
| .01855 | 291.89 | 38.07 | 50. | 39. | 31. | .68 | .66 | .141 | 3.611 | 79. | 39.33 | 3.44 | 66. | 41. |
| .02246 | 319.06 | 27.76 | 46. | 63. | 24. | .92 | .53 | .060 | 5.903 | 96. | 51.04 | 1.24 | 64. | 94. |

*** STATION 85 ***

DOMAINE BF

DECOUPAGE EN 16

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .08594 | 92.41 | 14.19 | 23. | 72. | 122. | .77 | .93 | .428 | .198 | 201. | 5.91 | 8.87 | -33. | -17. |
| .10156 | 83.21 | 16.81 | 18. | 34. | 124. | .92 | .98 | .233 | .059 | 204. | 1.96 | 2.57 | -22. | -17. |
| .12500 | 58.91 | 34.45 | 10. | 97. | 299. | .28 | .73 | .716 | .121 | 204. | 16.83 | 8.91 | -13. | -17. |
| .14844 | 58.44 | 13.13 | 21. | 3. | 301. | .05 | .49 | .854 | .235 | 205. | 13.51 | 5.93 | 122. | -39. |
| .17969 | 202.86 | 57.07 | 115. | 11. | 218. | .29 | .20 | .970 | .242 | 205. | 27.94 | 52.53 | 129. | 125. |
| .21094 | 330.81 | 15.55 | 112. | 4. | 220. | .48 | .26 | .522 | .307 | 210. | 6.44 | 22.52 | -40. | 122. |
| .25000 | 74.43 | 35.33 | -133. | 4. | 226. | .07 | .15 | 5.487 | .584 | 209. | 15.35 | 55.67 | 127. | 131. |
| .29687 | 55.49 | 13.16 | -149. | 12. | 218. | .01 | .05 | 2.416 | .259 | 211. | 16.41 | 28.39 | -41. | -43. |

DECOUPAGE EN 4

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 180.31 | 19.48 | 40. | 46. | 125. | .88 | .96 | .109 | .223 | 206. | 2.24 | .46 | 112. | -17. |
| .02539 | 206.99 | 29.52 | 40. | 48. | 126. | .89 | 1.00 | .044 | .249 | 206. | 2.30 | .78 | 87. | 36. |
| .03125 | 176.23 | 15.78 | 36. | 43. | 122. | 1.00 | 1.00 | .014 | .164 | 201. | .61 | .54 | 106. | 13. |
| .03711 | 171.42 | 19.27 | 34. | 41. | 126. | .96 | 1.00 | .071 | .196 | 189. | 1.81 | .53 | 59. | 36. |
| .04492 | 169.41 | 19.55 | 30. | 39. | 125. | .90 | 1.00 | .083 | .272 | 209. | 1.22 | 1.55 | 109. | -1. |
| .05273 | 140.13 | 21.70 | 25. | 46. | 122. | .90 | .96 | .054 | .074 | 201. | .44 | .46 | -12. | -33. |
| .06250 | 127.94 | 16.31 | 26. | 38. | 124. | .61 | .94 | .138 | .195 | 197. | .51 | 1.97 | -44. | -8. |
| .07422 | 116.34 | 11.93 | 20. | 44. | 301. | .76 | .99 | .082 | .025 | 199. | .37 | .31 | -33. | -43. |
| .08934 | 103.60 | 12.25 | 18. | 47. | 125. | .66 | .99 | .108 | .154 | 203. | .05 | .65 | -13. | -28. |

DECOUPAGE EN 1

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 131.25 | 33.66 | 57. | 116. | 139. | .76 | 1.00 | .342 | .567 | 210. | 7.04 | 2.22 | 98. | 131. |
| .00635 | 115.31 | 22.21 | 56. | 59. | 134. | .73 | 1.00 | .206 | .942 | 209. | 2.00 | 19.46 | 94. | 26. |
| .00781 | 146.76 | 4.59 | 36. | -40. | 123. | .55 | .89 | .170 | .030 | 212. | 1.59 | .77 | 23. | 10. |
| .00928 | 157.34 | 2.82 | 55. | 85. | 127. | .38 | .99 | .183 | .305 | 209. | .15 | 6.15 | 100. | 18. |
| .01123 | 168.11 | 46.12 | 53. | 60. | 137. | .75 | 1.00 | .095 | .627 | 208. | 1.15 | .70 | 89. | -21. |
| .01318 | 166.96 | 13.65 | 52. | 48. | 125. | .82 | .94 | .021 | .242 | 195. | 1.60 | .62 | 94. | 30. |
| .01562 | 182.84 | 19.53 | 46. | 42. | 130. | .59 | .98 | .029 | .312 | 197. | 2.53 | .28 | 65. | 95. |
| .01855 | 197.91 | 19.19 | 45. | 70. | 124. | .73 | 1.00 | .066 | .095 | 204. | .75 | .33 | 84. | 96. |
| .02246 | 183.86 | 19.36 | 44. | 46. | 125. | .95 | 1.00 | .041 | .157 | 199. | .36 | .21 | 53. | 5. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .66750 | 117.62 | 7.58 | 32. | 76. | 257. | .48 | .45 | 1.201 | 1.745 | 199. | 151.25 | 72.15 | -34. | -42. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .81250 | 999.35 | 959.92 | -171. | 3. | 180. | .43 | .82 | 2.651 | 2.064 | 170. | 3319.81 | 1148.23 | 132. | -43. |
| .93750 | 33.51 | 23.62 | 96. | 19. | 136. | .16 | .38 | 1.007 | .837 | 188. | 35.16 | 11.63 | 127. | 134. |
| 1.18750 | 71.76 | 41.29 | 103. | 18. | 179. | .21 | .46 | 1.259 | 1.830 | 197. | 126.21 | 44.03 | 122. | 126. |
| 1.43750 | 120.92 | 103.08 | 8. | 91. | 269. | .35 | .65 | 1.124 | 2.466 | 190. | 227.36 | 73.66 | 122. | 130. |
| 1.68750 | 42.48 | 21.74 | 27. | 70. | 283. | .13 | .17 | .692 | 1.559 | 192. | 30.26 | 10.30 | 127. | -36. |
| 2.00000 | 22.22 | 15.47 | 41. | 63. | 262. | .07 | .60 | .611 | 1.255 | 192. | 15.83 | 9.62 | -32. | -36. |
| 2.37500 | 37.33 | 12.42 | 49. | 44. | 139. | .16 | .58 | .477 | 1.048 | 197. | 10.28 | 2.74 | 126. | -25. |
| 2.87500 | 31.01 | 2.93 | 35. | 116. | 124. | .11 | .94 | .834 | .168 | 208. | 4.95 | 7.06 | -26. | -17. |
| 3.37500 | 28.69 | 17.90 | 81. | 20. | 171. | .10 | .05 | .783 | 7.057 | 201. | 29.20 | 14.32 | 122. | 130. |
| 4.00000 | 29.03 | 16.02 | 51. | 66. | 152. | .08 | .69 | .446 | 1.449 | 208. | 1.02 | 3.27 | -40. | -24. |
| 4.81250 | 32.09 | 11.57 | 49. | 63. | 137. | .27 | .25 | .539 | .661 | 206. | 4.28 | 5.73 | -37. | -16. |
| 5.75000 | 23.69 | 8.75 | 62. | 67. | 131. | .40 | .92 | .354 | .334 | 208. | .85 | 1.77 | -15. | -19. |
| 6.81250 | 23.74 | 17.01 | 63. | 63. | 274. | .19 | .09 | .284 | 1.806 | 208. | 2.80 | 1.50 | -25. | -16. |
| 8.06250 | 24.02 | 16.52 | 66. | 58. | 146. | .76 | .70 | .140 | 1.142 | 209. | .09 | .39 | -18. | -13. |
| 9.62500 | 29.62 | 16.72 | 75. | 55. | 157. | .68 | .35 | .212 | 4.024 | 209. | 3.89 | .36 | 117. | 131. |
| 11.5000 | 28.80 | 21.55 | 66. | 75. | 289. | .21 | .16 | .333 | 1.385 | 211. | 4.10 | 2.52 | -27. | -14. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 253.64 | 83.13 | 91. | 29. | 220. | .49 | .35 | .421 | .307 | 204. | 29.14 | 51.24 | 133. | 126. |
| .35937 | 276.48 | 48.06 | -147. | 34. | 219. | .35 | .28 | .802 | .410 | 211. | 51.13 | 56.15 | 81. | 92. |
| .42187 | 496.79 | 189.68 | -111. | -9. | 211. | .56 | .42 | 1.269 | .234 | 209. | 49.38 | 49.38 | -31. | -31. |
| .50000 | 114.41 | 22.13 | 22. | 17. | 258. | .20 | .37 | .226 | 1.495 | 208. | 11.48 | 11.65 | -41. | 106. |
| .59375 | 79.73 | 28.98 | 3. | 107. | 290. | .04 | .36 | 1.524 | .357 | 207. | 81.11 | 52.05 | 132. | 129. |
| .71875 | 119.92 | 51.56 | -153. | 12. | 208. | .03 | .08 | 2.893 | .132 | 208. | 90.02 | 74.86 | 120. | 119. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 31.95 | 21.86 | 67. | 83. | 296. | .22 | .91 | .504 | .855 | 152. | 9.41 | 5.16 | -34. | -23. |
| 14.0000 | 33.11 | 18.53 | 73. | 71. | 147. | .76 | .95 | .259 | 1.242 | 196. | 1.73 | 1.07 | 133. | -24. |
| 17.0000 | 45.11 | 17.73 | 73. | 73. | 150. | .71 | .97 | .221 | 1.537 | 191. | .68 | 1.21 | 124. | -19. |
| 20.0000 | 53.49 | 23.92 | 77. | 74. | 139. | .78 | .62 | .393 | 1.005 | 199. | 8.79 | 2.66 | 132. | -29. |
| 24.0000 | 51.65 | 9.29 | 74. | 87. | 138. | .39 | .97 | .394 | .659 | 206. | .69 | 4.06 | -22. | -19. |
| 29.0000 | 55.54 | .15 | 73. | 20. | 135. | .12 | .89 | .562 | .528 | 212. | .16 | 4.36 | 3. | -8. |
| 35.0000 | 63.74 | 12.77 | 75. | 77. | 137. | .52 | 1.00 | .265 | .643 | 203. | .40 | 2.31 | -39. | -12. |
| 41.0000 | 72.52 | 37.67 | 77. | 74. | 142. | .78 | .87 | .211 | 1.062 | 197. | 3.07 | 1.37 | 135. | -12. |
| 49.0000 | 78.69 | 37.66 | 78. | 75. | 156. | .72 | .94 | .176 | 1.951 | 177. | 1.66 | 1.00 | 122. | -17. |
| 58.0000 | 82.22 | 20.50 | 55. | 73. | 218. | .51 | .92 | .755 | .276 | 209. | 20.82 | 26.17 | 79. | 78. |
| 70.0000 | 131.34 | 56.06 | 76. | 73. | 170. | .76 | .93 | .025 | 3.231 | 175. | 4.23 | .61 | 90. | 125. |
| 83.0000 | 114.06 | 16.76 | 76. | 76. | 138. | .50 | .98 | .304 | .670 | 208. | .24 | 5.46 | -30. | -18. |
| 98.0000 | 150.38 | 65.13 | 74. | 77. | 157. | .83 | .97 | .135 | 2.836 | 190. | 1.47 | 1.37 | 114. | -23. |
| 117.000 | 129.87 | 11.58 | 76. | 61. | 139. | .39 | .96 | .321 | .721 | 208. | .22 | 7.17 | 118. | -23. |

*** STATION B6 ***

DOMAINE BF

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .06594 | 57.92 | 24.07 | 51. | 32. | 171. | .83 | .90 | .367 | .314 | 162. | 4.17 | 5.07 | -42. | -36. |
| .10156 | 59.76 | 19.45 | 57. | 30. | 156. | .56 | .49 | .383 | 1.009 | 171. | 4.10 | 4.69 | 124. | -33. |
| .12500 | 53.62 | 32.32 | 67. | 32. | 167. | .42 | .36 | .679 | .270 | 142. | 16.22 | 12.19 | 131. | -43. |
| .14844 | 47.33 | 31.98 | 112. | 19. | 174. | .29 | .34 | 1.079 | .235 | 159. | 28.66 | 23.37 | -34. | -29. |
| .17969 | 54.42 | 27.37 | -160. | 15. | 174. | .20 | .34 | 2.468 | .233 | 148. | 44.21 | 27.69 | -37. | -34. |
| .21094 | 153.03 | 56.32 | -172. | -2. | 159. | .21 | .16 | 1.528 | .825 | 160. | 105.14 | 15.81 | 130. | -42. |
| .25000 | 94.41 | 42.79 | -144. | 27. | 178. | .11 | .07 | 3.298 | .120 | 162. | 60.62 | 53.73 | 135. | 134. |
| .29687 | 300.46 | 61.15 | -123. | 22. | 169. | .19 | .10 | 2.348 | .398 | 166. | 257.76 | 128.93 | -38. | -38. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02143 | 123.10 | 33.71 | 41. | 54. | 211. | .94 | 1.00 | .095 | 1.487 | 178. | 3.33 | 1.98 | -19. | 34. |
| .02539 | 94.57 | 51.24 | 34. | 54. | 213. | .95 | .99 | .163 | 2.431 | 176. | 2.75 | 2.01 | 109. | 75. |
| .03125 | 94.69 | 46.80 | 32. | 48. | 199. | .96 | 1.00 | .232 | .838 | 168. | 1.88 | 3.75 | 84. | 66. |
| .03711 | 78.84 | 43.36 | 31. | 42. | 191. | .95 | 1.00 | .254 | .623 | 183. | 2.64 | 4.00 | 72. | 67. |
| .04492 | 75.55 | 39.48 | 34. | 37. | 190. | .96 | .97 | .236 | .477 | 172. | 1.46 | 2.34 | 80. | 74. |
| .05273 | 80.96 | 38.34 | 27. | 40. | 188. | .94 | .96 | .212 | 1.144 | 180. | 1.31 | 1.77 | 84. | 110. |
| .06250 | 65.79 | 36.56 | 26. | 39. | 197. | .87 | .94 | .134 | 1.515 | 177. | .97 | 1.31 | 92. | 76. |
| .07422 | 60.19 | 37.55 | 20. | 31. | 180. | .94 | .98 | .074 | 1.773 | 169. | 1.92 | 1.92 | 113. | 113. |
| .08984 | 54.69 | 31.48 | 16. | 41. | 204. | .84 | .86 | .069 | 1.951 | 174. | 1.93 | .63 | 107. | 82. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 66.92 | 25.66 | 52. | 62. | 190. | .98 | 1.00 | .407 | .677 | 178. | 2.63 | 2.12 | 118. | 108. |
| .00635 | 66.70 | 29.34 | 50. | 62. | 195. | .95 | .97 | .274 | .620 | 178. | 1.49 | 2.85 | 67. | 63. |
| .00781 | 57.64 | 31.41 | 49. | 58. | 194. | .81 | .98 | .235 | .575 | 176. | 1.41 | 2.20 | 79. | 68. |
| .00928 | 69.57 | 31.90 | 52. | 56. | 188. | .93 | .98 | .257 | .306 | 178. | 1.98 | 3.17 | 71. | 70. |
| .01123 | 73.64 | 39.70 | 49. | 60. | 191. | .95 | 1.00 | .257 | .410 | 178. | 1.95 | 3.59 | 62. | 60. |
| .01318 | 94.06 | 46.37 | 52. | 57. | 186. | .97 | .98 | .255 | .222 | 178. | 2.64 | 4.09 | 65. | 64. |
| .01562 | 97.44 | 41.52 | 45. | 54. | 191. | .96 | .99 | .262 | .414 | 182. | 2.09 | 4.50 | 63. | 62. |
| .01855 | 95.56 | 47.57 | 39. | 59. | 201. | .99 | 1.00 | .147 | 1.110 | 179. | 2.58 | 2.09 | 110. | 84. |
| .02246 | 96.45 | 48.48 | 44. | 51. | 195. | .99 | .99 | .218 | .518 | 180. | 1.39 | 3.78 | 54. | 55. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 79.33 | 32.36 | 45. | 134. | 245. | .62 | .37 | 1.263 | 1.302 | 117. | 118.91 | 42.59 | -40. | -37. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .81250 | 299.59 | 194.16 | 11. | 21. | 230. | .84 | .36 | 3.236 | 5.134 | 130. | 946.90 | 268.07 | 134. | 134. |
| .93750 | 96.54 | 4.94 | 31. | 119. | 238. | .10 | .35 | 1.092 | 3.468 | 113. | 106.90 | 31.56 | -34. | -33. |
| 1.18750 | 88.74 | 25.68 | 5. | 99. | 231. | .58 | .30 | 1.189 | 5.493 | 130. | 127.78 | 34.50 | 128. | 133. |
| 1.43750 | 96.18 | .76 | 43. | 26. | 231. | .63 | .64 | 1.324 | 5.545 | 119. | 127.79 | 37.77 | -26. | -24. |
| 1.68750 | 48.24 | 27.99 | 78. | -1. | 126. | .45 | .25 | .941 | 3.444 | 129. | 72.63 | 10.52 | 110. | 105. |
| 2.00000 | 55.62 | 20.43 | 26. | 98. | 238. | .29 | .10 | .943 | 2.534 | 134. | 71.21 | 15.16 | 128. | -40. |
| 2.37500 | 95.98 | 27.25 | 23. | 127. | 230. | .58 | .31 | 1.394 | 4.219 | 149. | 160.95 | 43.13 | 134. | -39. |
| 2.87500 | 67.56 | 16.64 | 61. | 20. | 114. | .55 | .26 | .665 | 1.610 | 150. | 47.86 | 4.81 | 113. | 106. |
| 3.37500 | 53.07 | 1.20 | 53. | 47. | 229. | .83 | .12 | .910 | 6.717 | 170. | 47.25 | 14.40 | -19. | -23. |
| 4.00000 | 35.69 | 9.51 | 51. | 69. | 242. | .64 | .27 | .484 | 1.608 | 152. | 12.58 | 4.25 | -32. | -27. |
| 4.61250 | 44.42 | 9.15 | 54. | 65. | 245. | .78 | .37 | .456 | 1.228 | 151. | 13.35 | 4.55 | -27. | -25. |
| 5.75000 | 24.90 | 12.72 | 61. | 66. | 253. | .77 | .44 | .254 | .990 | 124. | 2.83 | .75 | -36. | -24. |
| 6.81250 | 27.46 | 13.20 | 71. | 57. | 252. | .92 | .74 | .192 | 1.075 | 171. | 2.32 | .73 | 5. | -17. |
| 8.06250 | 27.12 | 13.77 | 68. | 62. | 256. | .97 | .92 | .143 | .658 | 177. | 1.04 | .47 | -4. | -21. |
| 9.62500 | 31.09 | 15.30 | 70. | 63. | 253. | .93 | .85 | .169 | .781 | 171. | 1.69 | .71 | -3. | -17. |
| 11.50000 | 34.89 | 16.35 | 74. | 62. | 247. | .83 | .11 | .343 | 1.440 | 175. | 5.93 | 3.48 | -2. | -21. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 43.87 | 16.44 | -143. | 12. | 177. | .27 | .12 | 1.616 | .097 | 160. | 8.27 | 6.14 | 115. | 111. |
| .35937 | 25.58 | 14.63 | 132. | 61. | 156. | .47 | .15 | 1.018 | 1.837 | 104. | 36.08 | 22.59 | -33. | -26. |
| .42187 | 44.14 | 15.48 | -122. | 27. | 175. | .52 | .16 | 1.968 | .602 | 250. | 35.45 | 32.47 | 111. | 107. |
| .50000 | 71.07 | 3.39 | 72. | 11. | 136. | .65 | .23 | .755 | 1.873 | 152. | 50.65 | 9.41 | 90. | 77. |
| .59375 | 26.19 | 23.16 | 13. | 106. | 215. | .50 | .09 | .959 | 1.960 | 195. | 43.91 | 10.14 | 127. | -44. |
| .71875 | 3191.63 | 325.31 | 82. | 47. | 174. | .15 | .73 | 1.024 | .567 | 155. | 959.55 | 904.51 | -43. | -39. |

DOMAINE MF

DECOUPAGE EN 54

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 35.79 | 15.77 | 65. | 71. | 250. | .99 | .98 | .243 | .931 | 99. | 3.71 | 1.26 | -24. | -21. |
| 14.0000 | 40.12 | 19.44 | 71. | 72. | 255. | .99 | .99 | .151 | .587 | 105. | 1.67 | .59 | -21. | -20. |
| 17.0000 | 44.62 | 23.10 | 71. | 75. | 256. | .98 | .99 | .157 | .655 | 99. | 2.10 | .56 | -30. | -23. |
| 20.0000 | 46.67 | 25.04 | 72. | 74. | 256. | .99 | .99 | .135 | .533 | 109. | 1.62 | .62 | -20. | -19. |
| 24.0000 | 98.19 | 13.64 | 65. | 102. | 234. | .98 | .92 | .592 | 3.046 | 104. | 54.47 | 14.18 | -23. | -20. |
| 29.0000 | 59.58 | 22.90 | 76. | 73. | 259. | .89 | .97 | .162 | .619 | 91. | 3.11 | 1.09 | 7. | -18. |
| 35.0000 | 66.10 | 37.04 | 76. | 77. | 263. | .98 | 1.00 | .086 | .253 | 98. | .75 | .37 | -16. | -12. |
| 41.0000 | 80.75 | 40.48 | 73. | 82. | 248. | .96 | .96 | .192 | 1.197 | 105. | 6.89 | 1.70 | -24. | -15. |
| 49.0000 | 83.30 | 46.08 | 71. | 82. | 247. | .94 | .97 | .190 | 1.348 | 102. | 7.05 | 1.87 | -28. | -18. |
| 58.0000 | 185.26 | 125.87 | 34. | 113. | 210. | .82 | .72 | .759 | 2.301 | 138. | 232.58 | 92.49 | 130. | 126. |
| 70.0000 | 104.52 | 103.33 | 97. | 53. | 131. | .69 | .83 | .342 | 4.125 | 129. | 52.17 | 15.97 | 131. | -45. |
| 83.0000 | 151.69 | 46.45 | 76. | 89. | 238. | .91 | .98 | .327 | 2.034 | 91. | 34.30 | 10.39 | -10. | -10. |
| 98.0000 | 140.37 | 73.30 | 75. | 82. | 222. | .90 | .98 | .156 | .776 | 95. | 7.19 | 2.26 | -19. | -15. |
| 117.1000 | 156.24 | 80.55 | 74. | 80. | 240. | .78 | .88 | .236 | 1.155 | 91. | 16.19 | 5.21 | -18. | -14. |

*** STATION A7 ***

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 445.21 | 266.06 | 116. | 4. | 257. | .57 | .49 | 1.525 | .363 | 224. | 167.28 | 276.05 | -43. | 132. |
| .81250 | 321.39 | 194.72 | 112. | 17. | 254. | .45 | .49 | 1.171 | .214 | 234. | 116.00 | 161.77 | -39. | -43. |
| .93750 | 257.27 | 52.11 | -178. | 34. | 259. | .30 | .30 | 1.325 | .686 | 238. | 26.54 | 73.41 | 128. | 126. |
| 1.18750 | 66.38 | 26.78 | 72. | 27. | 251. | .36 | .15 | .881 | .435 | 241. | 29.21 | 27.77 | -31. | -38. |
| 1.43750 | 45.42 | 14.54 | 64. | 28. | 266. | .45 | .32 | .878 | .637 | 243. | 14.13 | 17.32 | -32. | -43. |
| 1.68750 | 37.12 | 13.96 | 77. | 48. | 223. | .23 | .26 | .767 | .655 | 244. | 10.14 | 6.67 | 132. | -34. |
| 2.00000 | 20.95 | 10.57 | 46. | 14. | 173. | .03 | .49 | 1.177 | .434 | 246. | 3.04 | 8.56 | -34. | -16. |
| 2.37500 | 19.94 | 7.44 | 52. | 41. | 197. | .26 | .50 | .598 | 1.208 | 246. | 1.47 | 2.29 | 121. | -37. |
| 2.87500 | 22.63 | 7.71 | 65. | 59. | 221. | .43 | .46 | .518 | .928 | 243. | 2.24 | 1.52 | 122. | -38. |
| 3.37500 | 35.54 | 4.76 | 45. | 51. | 232. | .20 | .24 | .308 | .638 | 237. | 1.74 | 1.92 | 101. | 123. |
| 4.00000 | 50.32 | 5.40 | 64. | 45. | 219. | .60 | .74 | .360 | 1.584 | 240. | 11.73 | 2.68 | 92. | 106. |
| 4.81250 | 383.96 | 10.32 | 53. | 6. | 224. | .58 | .74 | .535 | 1.184 | 244. | 12.93 | 13.55 | 73. | -19. |
| 5.75000 | 31.09 | 6.75 | 51. | 60. | 248. | .50 | .62 | .129 | .247 | 247. | .39 | .15 | 76. | 83. |
| 6.81250 | 35.38 | 5.75 | 79. | 60. | 241. | .99 | .59 | .245 | .541 | 251. | 1.42 | .61 | 79. | 71. |
| 8.00250 | 33.83 | 7.58 | 55. | 63. | 245. | .96 | .85 | .113 | .132 | 248. | .43 | .24 | 71. | 72. |
| 9.62500 | 36.65 | 7.51 | 59. | 64. | 247. | .89 | .73 | .111 | .089 | 246. | .29 | .23 | 72. | 72. |
| 11.5000 | 53.21 | 12.58 | 56. | 67. | 241. | .41 | .54 | .248 | .250 | 248. | 2.33 | 1.57 | 91. | 99. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 1749.94 | 534.59 | -8. | 42. | 297. | .17 | .21 | 2.254 | 1.413 | 256. | 2694.33 | 1358.65 | 135. | -20. |
| .35937 | 1641.49 | 386.30 | -33. | 97. | 319. | .42 | .28 | 2.034 | .721 | 232. | 2442.95 | 931.17 | 127. | 119. |
| .42187 | 664.02 | 242.69 | 70. | -187. | 281. | .26 | .11 | 1.359 | 1.610 | 244. | 885.46 | 301.99 | -11. | -27. |
| .50000 | 734.19 | 569.55 | -43. | 115. | 316. | .34 | .32 | 2.539 | .929 | 247. | 886.86 | 160.80 | 117. | 119. |
| .59375 | 146.19 | 86.22 | -18. | 126. | 329. | .10 | .19 | 2.612 | .419 | 247. | 170.52 | 63.16 | -38. | 127. |
| .71875 | 3430.12 | 180.37 | -87. | 64. | 265. | .09 | .39 | 1.336 | .859 | 251. | 176.04 | 1002.92 | -43. | -32. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 43.49 | 8.53 | 61. | 64. | 242. | .94 | .97 | .160 | .231 | 213. | .84 | .50 | 98. | 109. |
| 14.0000 | 43.66 | 9.10 | 63. | 65. | 241. | .95 | .93 | .143 | .259 | 139. | 1.13 | .56 | 95. | 107. |
| 17.0000 | 47.09 | 10.40 | 62. | 64. | 244. | .93 | .97 | .191 | .147 | 193. | 1.23 | 1.13 | 112. | 118. |
| 20.0000 | 55.47 | 11.56 | 63. | 65. | 240. | .94 | .98 | .121 | .236 | 232. | .75 | .28 | 94. | 114. |
| 24.0000 | 58.16 | 12.41 | 63. | 64. | 242. | .90 | .92 | .109 | .217 | 231. | .70 | .28 | 92. | 104. |
| 29.0000 | 38.38 | 8.22 | 84. | 105. | 221. | .20 | .46 | .374 | 1.241 | 245. | 5.76 | 1.10 | 85. | 68. |
| 35.0000 | 68.99 | 15.97 | 62. | 64. | 242. | .95 | .94 | .096 | .204 | 234. | .75 | .25 | 90. | 103. |
| 41.0000 | 76.54 | 14.95 | 62. | 63. | 242. | .93 | .97 | .059 | .216 | 229. | .66 | .09 | 76. | 76. |
| 49.0000 | 83.78 | 14.32 | 63. | 62. | 243. | .99 | .96 | .075 | .179 | 238. | .81 | .20 | 73. | 69. |
| 58.0000 | 113.90 | .36 | 66. | 36. | 239. | .94 | .63 | .538 | .356 | 246. | 22.03 | 10.05 | 84. | 86. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70.0000 | 111.92 | 5.47 | 62. | 60. | 239. | .99 | .66 | .291 | .335 | 245. | 10.15 | 3.92 | 83. | 88. |
| 83.0000 | 94.28 | 15.64 | 65. | 62. | 239. | .74 | .77 | .089 | .322 | 237. | 1.51 | .17 | 81. | 96. |
| 95.0000 | 102.02 | 16.63 | 65. | 62. | 242. | .94 | .91 | .065 | .224 | 237. | 1.14 | .19 | 74. | 73. |
| 117.000 | 104.52 | 14.69 | 61. | 61. | 239. | .86 | .74 | .080 | .328 | 238. | 1.99 | .24 | 81. | 93. |

DOMAINE 8F

DECOUPAGE EN 32

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .17157 | 948.59 | 262.05 | 22. | 40. | 171. | .66 | .36 | 2.385 | .636 | 246. | 172.90 | 706.99 | 130. | -16. |
| .20312 | 3045.45 | 224.71 | . | 16. | 330. | .20 | .58 | 1.285 | .408 | 246. | 1416.24 | 871.95 | 128. | -35. |
| .25000 | 6648.76 | 1483.98 | 7. | 9. | 336. | .40 | .66 | 1.864 | .081 | 243. | 3513.38 | 3006.75 | -38. | -41. |
| .29687 | 10345.77 | 379.33 | 36. | 34. | 328. | .14 | .31 | .942 | .395 | 246. | 3726.75 | 1454.97 | 132. | 128. |

DECOUPAGE EN 8

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .04297 | 211.84 | 194.26 | 19. | 38. | 338. | .99 | .29 | .205 | 1.004 | 254. | 23.88 | 6.54 | 112. | -17. |
| .05078 | 419.65 | 29.62 | 9. | 2. | 302. | .66 | .46 | .858 | 1.715 | 249. | 338.31 | 103.14 | -31. | -40. |
| .06250 | 604.43 | 27.77 | 40. | 12. | 305. | .95 | .16 | .902 | 2.565 | 250. | 508.01 | 185.16 | -24. | -33. |
| .07422 | 217.44 | 77.87 | -22. | 130. | 160. | .17 | .06 | 3.003 | .452 | 248. | 294.37 | 50.51 | -13. | -19. |
| .08984 | 9871.86 | 687.24 | -14. | -304. | 331. | .20 | .28 | .904 | .258 | 248. | 2222.01 | 1492.75 | 130. | -38. |
| .10547 | 36869.24 | 964.51 | 62. | 16. | 171. | .09 | .51 | .517 | .783 | 247. | 12395.76 | 78.03 | 110. | 105. |
| .12500 | 38210.42 | 775.91 | 66. | 35. | 333. | .52 | .47 | .485 | .165 | 244. | 2674.04 | 2170.61 | 134. | 125. |
| .14844 | 11559.46 | 195.00 | -36. | 109. | 335. | .09 | .44 | .986 | .428 | 249. | 5479.31 | 729.74 | -28. | -41. |
| .17969 | 1146.10 | 207.17 | -39. | 10. | 317. | .07 | .02 | 2.236 | .927 | 247. | 1304.05 | 816.02 | 116. | -42. |

DECOUPAGE EN 2

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .01074 | 234.75 | 46.13 | 56. | -14. | 205. | .98 | .65 | .499 | 1.933 | 249. | 135.70 | 31.51 | 81. | 57. |
| .01270 | 281.46 | 96.92 | 58. | 43. | 183. | 1.00 | .73 | .257 | 1.498 | 249. | 52.13 | 3.79 | 98. | 77. |
| .01562 | 917.51 | 66.92 | 34. | 38. | 173. | .96 | .99 | .316 | .730 | 248. | 181.14 | 30.22 | 82. | 50. |
| .01855 | 255.37 | 134.39 | 30. | 48. | 183. | .99 | .83 | .196 | .652 | 248. | 20.43 | 7.80 | 62. | 49. |
| .02246 | 977.39 | 121.13 | 31. | 45. | 166. | .99 | .70 | .145 | .375 | 248. | 43.67 | 1.23 | 86. | 60. |
| .02637 | 900.65 | 134.55 | 36. | 47. | 161. | .97 | .93 | .081 | .142 | 252. | 9.87 | .40 | 104. | -32. |
| .03125 | 851.60 | 142.14 | 37. | 45. | 161. | .97 | .52 | .116 | .222 | 242. | 18.12 | .55 | 98. | 91. |
| .03711 | 433.12 | 123.73 | 40. | 56. | 320. | .89 | .43 | .350 | 1.141 | 246. | 100.96 | 23.76 | -44. | -21. |
| .04492 | 391.02 | 17.04 | 17. | -234. | 205. | .93 | .09 | 1.059 | 2.768 | 248. | 423.88 | 98.68 | 57. | 46. |

*** STATION A8 ***

DOMAINE MF

DECOUPAGE EN 24

| FREQ | KMAX | KMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .66750 | 13817.59 | 7196.93 | 114. | 40. | 130. | .75 | .26 | 1.296 | .408 | 88. | 10487.12 | 18755.84 | -38. | -43. |
| .81250 | 20709.90 | 16099.40 | 81. | 31. | 96. | .79 | .91 | 1.099 | .279 | 77. | 17710.37 | 10608.38 | 132. | -42. |
| .93750 | 5913.23 | 266.43 | 72. | -15. | 85. | .82 | .90 | .850 | 1.456 | 92. | 2456.38 | 1007.47 | 108. | 128. |
| 1.18750 | 1731.81 | 90.66 | 64. | 42. | 101. | .14 | .93 | .746 | .452 | 88. | 178.91 | 266.90 | 133. | -35. |
| 1.43750 | 2349.22 | 390.11 | 67. | 72. | 68. | .41 | .88 | .542 | 1.102 | 99. | 280.57 | 80.79 | 113. | -23. |
| 1.56750 | 2016.70 | 85.34 | 52. | 113. | 52. | .36 | .88 | .679 | 1.432 | 101. | 221.07 | 187.47 | 101. | -41. |
| 2.00000 | 416.40 | 33.56 | 83. | 40. | 98. | .43 | .72 | .485 | .905 | 106. | 44.98 | 13.37 | 113. | -34. |
| 2.37500 | 182.07 | 7.52 | 65. | 29. | 73. | .14 | .21 | .342 | 3.810 | 105. | 11.31 | 6.69 | 91. | -12. |
| 2.87500 | 261.06 | 4.21 | 79. | 55. | 66. | .42 | .95 | .538 | 3.621 | 105. | 118.61 | 3.18 | 92. | -25. |
| 3.37500 | 457.95 | 2.02 | 62. | -6. | 65. | .17 | .90 | .193 | 5.454 | 80. | 75.35 | 3.66 | 82. | -22. |
| 4.00000 | 96.74 | 4.64 | 63. | 40. | 55. | .36 | .46 | .244 | 1.917 | 103. | 8.27 | 1.23 | 94. | -13. |
| 4.81250 | 166.19 | 3.97 | 67. | 35. | 54. | .55 | .44 | .243 | 7.255 | 106. | 15.64 | 3.10 | 86. | -15. |
| 5.75000 | 150.37 | 2.83 | 64. | 50. | 59. | .35 | .72 | .055 | 3.137 | 106. | 23.39 | .32 | 79. | -42. |
| 6.81250 | 117.17 | 3.18 | 60. | 83. | 58. | .57 | .63 | .228 | 2.604 | 100. | 8.65 | 2.47 | 73. | -28. |
| 8.06250 | 86.64 | 7.16 | 64. | 76. | 61. | .77 | .82 | .112 | 3.937 | 102. | 6.74 | .55 | 74. | -26. |
| 9.62500 | 87.89 | 6.80 | 62. | 68. | 63. | .70 | .73 | .052 | 5.368 | 92. | 6.77 | .04 | 77. | -30. |
| 11.50000 | 140.31 | 2.95 | 70. | 102. | 66. | .47 | .33 | .432 | 0 | 99. | 7.00 | 8.29 | 88. | -19. |

DECOUPAGE EN 6

| FREQ | KMAX | KMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 613963.7 | 126678.0 | 22. | -313. | 29. | .92 | .32 | 1.555 | .396 | 96. | 173851.9 | 92953.41 | 114. | -34. |
| .35937 | 521065.3 | 30323.50 | 41. | -294. | 37. | .57 | .38 | 1.260 | .776 | 70. | 98495.62 | 211158.6 | 125. | -4. |
| .42187 | 47700.95 | 10231.59 | 39. | . | 39. | .19 | .44 | 1.286 | .715 | 109. | 43300.79 | 7968.81 | 113. | -21. |
| .50000 | 61959.31 | 29951.53 | -1. | 8. | 24. | .38 | .44 | 2.405 | .318 | 96. | 42418.01 | 28253.35 | 115. | 133. |
| .59375 | 25592.41 | 1230.55 | 91. | -27. | 71. | .18 | .07 | 1.084 | 1.659 | 108. | 8118.41 | 2064.90 | 120. | -10. |
| .71875 | 14893.16 | 9545.57 | -38. | -294. | 34. | .28 | .29 | 1.875 | .355 | 106. | 8622.72 | 7718.26 | -32. | 133. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | KMAX | KMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 54.44 | 9.54 | 68. | 60. | 74. | .90 | .97 | .270 | 3.059 | 84. | 1.76 | 1.00 | 93. | -22. |
| 14.0000 | 24.74 | 13.49 | 61. | 83. | 45. | .69 | .94 | .462 | 1.524 | 99. | 1.64 | 5.50 | 112. | 123. |
| 17.0000 | 54.06 | 15.74 | 61. | 102. | 65. | .82 | .97 | .407 | 5.172 | 90. | 1.04 | 3.65 | 88. | -36. |
| 20.0000 | 57.35 | 11.49 | 66. | 74. | 66. | .78 | .98 | .209 | 0 | 86. | 1.22 | 1.30 | 85. | -24. |
| 24.0000 | 47.47 | 15.02 | 63. | 65. | 57. | .70 | .95 | .219 | 2.654 | 76. | .97 | 1.69 | 85. | 134. |
| 29.0000 | 33.38 | 1.58 | 66. | 115. | 25. | .19 | .69 | .288 | 1.220 | 102. | .12 | 35.45 | 73. | 122. |
| 35.0000 | 55.14 | 18.66 | 59. | 102. | 96. | .56 | .43 | .364 | 2.725 | 94. | .91 | 6.22 | 82. | 131. |
| 41.0000 | 66.53 | 24.99 | 66. | 81. | 62. | .86 | .91 | .166 | 4.653 | 79. | 1.59 | 1.19 | 86. | -44. |
| 49.0000 | 93.83 | 15.52 | 71. | 75. | 69. | .91 | .57 | .153 | 3.653 | 89. | 3.75 | .36 | 90. | -19. |
| 58.0000 | 35.14 | 1.99 | 75. | 20. | 116. | .56 | .94 | .070 | .493 | 112. | 1.99 | 1.92 | -42. | 132. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79.0000 | 86.47 | 10.32 | 82. | 35. | 100. | .99 | .45 | .10[illegible] | .663 | 102. | 3.60 | 1.99 | 116. | -36. |
| 83.0000 | 80.04 | 47.[illegible] | 49. | 103. | 59. | .65 | .93 | .583 | 4.857 | 105. | 1.67 | 26.68 | 91. | 122. |
| 98.0000 | 126.35 | 38.21 | 74. | 84. | 73. | .94 | .89 | .172 | 3.164 | 94. | 3.29 | .82 | 91. | -22. |
| 117.000 | 79.53 | 45.91 | 60. | 91. | 63. | .66 | .77 | .389 | 7.898 | 108. | 2.18 | 10.23 | 101. | 125. |

DOMAINE 4F

DECOUPAGE EN 4E

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .06594 | 70.02 | 8.43 | 35. | 15. | 79. | .72 | .63 | .174 | 2.559 | 105. | 12.39 | 1.13 | 73. | 87. |
| .10156 | 52.80 | 15.95 | 32. | 7. | 85. | .46 | .81 | .336 | 1.784 | 108. | 11.73 | 9.76 | 96. | 109. |
| .12500 | 90.17 | 22.55 | 46. | 9. | 79. | .59 | .75 | .417 | 3.425 | 104. | 12.29 | 7.16 | 110. | 126. |
| .14844 | 24.76 | 17.69 | 74. | 21. | 105. | .18 | .46 | .636 | .550 | 107. | 11.40 | 8.79 | 133. | -42. |
| .17969 | 27.87 | 21.49 | 26. | 117. | 196. | .12 | .20 | .983 | .304 | 107. | 17.71 | 11.93 | -41. | -33. |
| .21094 | 69.19 | 19.97 | 35. | 126. | 190. | .26 | .29 | 1.094 | .434 | 109. | 43.00 | 41.14 | -34. | 130. |
| .25000 | 86.42 | 27.83 | 20. | 2. | 26. | .14 | .31 | 1.202 | .331 | 108. | 37.61 | 18.23 | 118. | -36. |
| .29687 | 51.59 | 39.64 | -8. | 16. | 198. | .16 | .28 | 3.681 | .311 | 110. | 32.16 | 26.77 | 128. | -34. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 66.90 | 11.12 | 40. | 62. | 83. | .93 | .84 | .153 | 1.849 | 93. | 6.76 | .19 | 65. | 76. |
| .02539 | 110.81 | 16.19 | 55. | 38. | 79. | .99 | .79 | .065 | 2.291 | 94. | 15.19 | .45 | 77. | 102. |
| .03125 | 149.47 | 14.95 | 48. | 3. | 79. | .99 | .96 | .146 | 2.641 | 83. | 29.53 | 2.35 | 79. | 99. |
| .03711 | 103.06 | 12.15 | 37. | 44. | 82. | .98 | .92 | .163 | 1.816 | 117. | 18.46 | 1.48 | 60. | 57. |
| .04492 | 95.69 | 16.59 | 31. | 39. | 82. | .97 | .96 | .186 | 1.899 | 108. | 15.73 | 1.46 | 56. | 55. |
| .05273 | 95.51 | 12.39 | 35. | 11. | 82. | 1.00 | .93 | .257 | 2.022 | 112. | 22.38 | 4.69 | 74. | 86. |
| .06250 | 79.05 | 12.13 | 32. | 21. | 82. | .93 | .86 | .192 | 1.830 | 110. | 13.57 | 2.62 | 69. | 84. |
| .07422 | 73.46 | 10.34 | 24. | 36. | 81. | .97 | .93 | .192 | 1.968 | 111. | 12.37 | 1.09 | 51. | 50. |
| .08984 | 67.02 | 9.17 | 22. | 34. | 80. | .99 | .79 | .160 | 2.153 | 110. | 10.47 | .68 | 51. | 52. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 14.12 | 1.36 | 65. | 121. | 195. | .17 | .97 | .703 | .356 | 129. | 4.26 | 2.73 | -7. | -21. |
| .00635 | 15.85 | 4.10 | 69. | 64. | 161. | .57 | .85 | .424 | 1.162 | 70. | 2.81 | 4.48 | -30. | 129. |
| .00781 | 25.43 | 1.54 | 66. | 71. | 145. | .35 | .94 | .122 | .832 | 43. | 4.74 | 4.45 | -5. | -38. |
| .00928 | 27.72 | 14.61 | 37. | 47. | 109. | .71 | .84 | .358 | 1.510 | 87. | 8.20 | 8.71 | 116. | 117. |
| .01123 | 20.91 | 15.94 | 44. | 39. | 104. | .69 | .86 | .511 | 1.336 | 84. | 6.50 | 6.38 | 110. | 111. |
| .01313 | 33.91 | 11.46 | 51. | 41. | 84. | .80 | .57 | .413 | 1.430 | 83. | 6.34 | 2.79 | 95. | 107. |
| .01562 | 57.35 | 15.13 | 48. | 54. | 84. | .86 | .89 | .234 | 1.597 | 100. | 8.64 | 1.57 | 69. | 68. |
| .01855 | 72.51 | 13.32 | 48. | 52. | 84. | .86 | .93 | .152 | 1.536 | 100. | 9.08 | 1.04 | 66. | 57. |
| .02246 | 67.92 | 11.39 | 41. | 55. | 86. | .83 | .79 | .193 | 1.459 | 103. | 9.43 | 1.22 | 64. | 66. |

*** STATION A9 ***

DOMAINE BF

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .08594 | 29.97 | 10.41 | 38. | 22. | 173. | .99 | .48 | .302 | 1.992 | 105. | 4.17 | 1.25 | -36. | 132. |
| .10156 | 24.75 | 9.68 | 32. | 27. | 172. | .95 | .33 | .330 | 1.899 | 111. | 4.13 | 1.21 | -44. | 132. |
| .12500 | 64.01 | 8.71 | 23. | 66. | 185. | .68 | .33 | .602 | .734 | 115. | 37.52 | 22.14 | -34. | 132. |
| .14844 | 115.42 | 17.94 | 25. | 95. | 191. | .30 | .17 | .899 | .771 | 116. | 81.22 | 28.72 | 130. | -42. |
| .17969 | 483.75 | 66.51 | -11. | 5. | 191. | .27 | .19 | 1.475 | .681 | 115. | 370.82 | 143.96 | 124. | -42. |
| .21094 | 780.35 | 96.97 | -8. | -309. | 196. | .16 | .09 | 1.354 | .388 | 113. | 413.04 | 200.18 | 133. | 133. |
| .25000 | 1498.06 | 104.91 | -10. | 25. | 197. | .20 | .23 | 1.366 | .377 | 115. | 788.84 | 365.81 | -44. | -44. |
| .29687 | 1021.10 | 106.42 | 1. | 29. | 196. | .08 | .06 | 1.523 | .403 | 116. | 615.91 | 286.23 | -43. | -44. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 46.73 | 11.22 | 45. | 47. | 156. | .97 | .94 | .150 | 2.526 | 111. | 4.17 | .07 | -32. | -42. |
| .02539 | 37.87 | 10.08 | 46. | 38. | 139. | .98 | .98 | .233 | 1.130 | 121. | 2.98 | 1.01 | -26. | -31. |
| .03125 | 41.06 | 12.52 | 41. | 39. | 154. | 1.00 | .94 | .068 | 3.231 | 119. | 2.33 | .04 | -28. | 128. |
| .03711 | 35.45 | 14.11 | 34. | 40. | 152. | 1.00 | .97 | .034 | 2.739 | 117. | .92 | .04 | -28. | 28. |
| .04492 | 34.46 | 13.01 | 30. | 39. | 155. | 1.00 | .95 | .010 | 3.930 | 110. | 1.44 | .01 | -36. | 6. |
| .05273 | 30.06 | 12.86 | 27. | 39. | 152. | .99 | .95 | .017 | 2.329 | 103. | .97 | .00 | -43. | 28. |
| .06250 | 27.75 | 10.89 | 29. | 31. | 152. | 1.00 | .95 | .049 | 2.533 | 108. | .96 | .00 | -36. | 126. |
| .07422 | 25.57 | 9.43 | 31. | 24. | 154. | .96 | .89 | .150 | 3.235 | 108. | 1.86 | .23 | -35. | 131. |
| .08984 | 21.93 | 9.00 | 34. | 41. | 156. | .98 | .16 | .254 | .870 | 114. | 2.72 | .51 | -40. | -19. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 21.49 | 6.06 | 56. | 49. | 174. | .91 | .96 | .047 | 2.313 | 59. | .86 | .06 | -17. | 108. |
| .00635 | 22.85 | 7.55 | 63. | 48. | 162. | .95 | .99 | .091 | 2.157 | 68. | 1.49 | .04 | 4. | 113. |
| .00781 | 19.20 | 9.41 | 51. | 59. | 153. | .95 | .97 | .167 | 3.083 | 80. | .55 | .64 | 127. | 101. |
| .00928 | 25.30 | 9.42 | 69. | 48. | 153. | .90 | .98 | .078 | 1.496 | 75. | 1.35 | .63 | -8. | 129. |
| .01123 | 30.90 | 12.61 | 54. | 55. | 155. | .95 | .98 | .054 | 3.837 | 125. | .55 | .05 | -16. | 70. |
| .01318 | 30.69 | 21.35 | 54. | 40. | 147. | .95 | .96 | .135 | 8.395 | 117. | 1.04 | .20 | -5. | -13. |
| .01562 | 45.46 | 12.86 | 52. | 50. | 153. | .97 | .98 | .103 | 6.407 | 115. | 3.11 | .16 | -10. | 25. |
| .01855 | 42.62 | 14.19 | 47. | 48. | 157. | .99 | .97 | .102 | 3.456 | 115. | 1.32 | .07 | -12. | 57. |
| .02246 | 39.81 | 13.98 | 43. | 50. | 148. | 1.00 | .98 | .015 | 1.906 | 135. | 1.49 | .00 | -30. | -45. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 354.97 | 25.35 | 27. | 116. | 208. | .67 | .58 | 1.181 | .180 | 107. | 148.18 | 153.59 | 134. | 128. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .81250 | 407.12 | 364.68 | 36. | 115. | 41. | .57 | .93 | 1.422 | .536 | 106. | 246.10 | 465.93 | 133. | 132. |
| .93750 | 3495.94 | 245.64 | 45. | 97. | 200. | .48 | .38 | .921 | .434 | 105. | 1823.82 | 731.41 | 132. | -42. |
| 1.18750 | 80.09 | 31.71 | 61. | 55. | 65. | .30 | .17 | .629 | 1.103 | 106. | 41.19 | 20.22 | 121. | 132. |
| 1.43750 | 328.77 | 19.99 | 53. | 64. | 36. | .22 | .69 | .759 | .387 | 114. | 101.71 | 40.73 | 111. | 118. |
| 1.68750 | 94.65 | 56.73 | 44. | 88. | 50. | .22 | .20 | .898 | 1.534 | 110. | 16.06 | 62.46 | 129. | 126. |
| 2.00000 | 78.14 | 8.99 | 56. | 69. | 190. | .09 | .14 | .638 | 1.027 | 113. | 14.10 | 31.36 | -43. | 118. |
| 2.37500 | 206.53 | 86.96 | 94. | 49. | 138. | .55 | .07 | .949 | .825 | 111. | 58.69 | 114.51 | 130. | 125. |
| 2.81250 | 1212.08 | 202.55 | 60. | 71. | 33. | .58 | .79 | 1.072 | .694 | 121. | 1095.55 | 348.64 | 121. | 125. |
| 3.37500 | 293.84 | 31.14 | 64. | 84. | 197. | .24 | .26 | .676 | .469 | 121. | 102.69 | 41.24 | -39. | -38. |
| 4.00000 | 158.98 | 35.39 | 54. | 101. | 134. | .36 | .17 | .578 | 1.286 | 108. | 75.18 | 15.19 | -45. | 134. |
| 4.81250 | 81.21 | 27.29 | 66. | 79. | 196. | .24 | .28 | .498 | .393 | 107. | 10.91 | 16.78 | 136. | 124. |
| 5.75000 | 62.65 | 26.97 | 73. | 60. | 44. | .29 | .23 | .584 | 1.629 | 114. | 36.19 | 5.79 | 111. | 93. |
| 6.81250 | 96.62 | 30.03 | 72. | 79. | 200. | .70 | .72 | .234 | .256 | 106. | 1.46 | 4.05 | 99. | 102. |
| 8.06250 | 50.33 | 37.90 | 78. | 79. | 207. | .68 | .82 | .114 | .860 | 121. | .91 | .58 | 104. | 76. |
| 9.62500 | 55.64 | 40.15 | 78. | 77. | 201. | .61 | .66 | .138 | .699 | 112. | .43 | 1.48 | 96. | 112. |
| 11.50000 | 108.54 | 53.36 | 92. | 76. | 79. | .62 | .09 | .582 | 1.414 | 119. | 47.06 | 20.55 | 109. | 106. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 1704.90 | 166.35 | -2. | -306. | 192. | .21 | .33 | 1.640 | .618 | 115. | 1512.79 | 488.15 | -33. | -41. |
| .35937 | 697.47 | 121.36 | 70. | 4. | 204. | .03 | .01 | .794 | 1.142 | 112. | 199.32 | 147.77 | 132. | 130. |
| .42187 | 905.21 | 197.37 | 84. | 132. | 198. | .51 | .37 | 1.063 | .680 | 115. | 753.58 | 287.44 | 129. | 122. |
| .50000 | 931.12 | 121.43 | 43. | -278. | 199. | .13 | .10 | 1.925 | .299 | 114. | 222.69 | 434.18 | 105. | 99. |
| .59375 | 830.58 | 161.66 | -10. | 109. | 188. | .02 | .07 | .746 | 1.034 | 114. | 594.47 | 78.36 | 110. | -37. |
| .71875 | 864.79 | 377.59 | 13. | 69. | 51. | .32 | .13 | .907 | 1.067 | 117. | 191.69 | 390.41 | -27. | -39. |

DOMAINE Hr

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 76.70 | 47.23 | 78. | 78. | 185. | .95 | .96 | .203 | .960 | 92. | 1.81 | 2.66 | 126. | 115. |
| 14.0000 | 79.96 | 58.29 | 78. | 77. | 194. | .95 | .96 | .153 | .740 | 96. | .71 | 2.42 | 116. | 117. |
| 17.0000 | 94.28 | 68.83 | 78. | 79. | 200. | 1.00 | .98 | .123 | .251 | 94. | .89 | 1.30 | 105. | 104. |
| 20.0000 | 105.75 | 72.16 | 78. | 79. | 197. | .98 | .98 | .124 | .365 | 95. | .91 | 1.47 | 115. | 110. |
| 24.0000 | 114.14 | 80.56 | 78. | 80. | 191. | .97 | .96 | .116 | .644 | 101. | .73 | 1.32 | 113. | 102. |
| 29.0000 | 123.74 | 9.22 | 75. | 61. | 150. | .98 | .18 | .148 | 1.788 | 164. | 22.63 | 2.00 | -7. | -30. |
| 35.0000 | 141.69 | 101.21 | 75. | 81. | 183. | .93 | .90 | .093 | 1.329 | 95. | 1.14 | .89 | 123. | 93. |
| 41.0000 | 170.14 | 129.48 | 78. | 79. | 196. | 1.00 | .97 | .081 | .472 | 103. | .66 | .90 | 107. | 93. |
| 49.0000 | 162.45 | 114.79 | 74. | 79. | 160. | .97 | .83 | .100 | 1.649 | 126. | 1.38 | 2.86 | 128. | 108. |
| 58.0000 | 185.44 | 5.53 | 78. | -2. | 132. | .81 | .94 | .315 | .564 | 126. | 30.47 | 6.63 | -9. | -22. |
| 70.0000 | 234.00 | 11.44 | 77. | 35. | 132. | .92 | .37 | .223 | .584 | 135. | 27.82 | 5.12 | -8. | -18. |
| 83.0000 | 265.96 | 161.92 | 73. | 80. | 160. | .90 | .70 | .085 | 0 | 152. | 4.83 | 1.48 | -37. | 112. |
| 98.0000 | 295.89 | 229.64 | 74. | 79. | 175. | .97 | .92 | .067 | 1.756 | 96. | 1.05 | 1.87 | 113. | 86. |
| 117.0000 | 322.62 | 120.01 | 75. | 90. | 150. | .91 | .58 | .048 | 1.515 | 93. | 9.39 | 1.08 | -19. | 52. |

*** STATION A10 ***

DOMAINE MF

DECOUPAGE EN 24

| FREQ | XMAX | XMIN | PHMAX | PHMIN | XOTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 58.68 | 12.33 | 56. | 119. | 25. | .41 | .22 | .920 | .579 | 277. | 6.24 | 40.14 | 126. | 120. |
| .81250 | 67.54 | 14.34 | 78. | 46. | 355. | .36 | .32 | .866 | 1.514 | 263. | 5.49 | 31.31 | -38. | 130. |
| .93750 | 33.65 | 12.98 | 54. | 17. | 347. | .71 | .77 | .526 | 2.591 | 269. | 1.33 | 10.53 | -30. | 116. |
| 1.18750 | 51.47 | 2.54 | 64. | -6. | 351. | .55 | .25 | .807 | 3.041 | 288. | .30 | 11.26 | -44. | 94. |
| 1.43750 | 44.77 | 4.71 | 57. | 45. | 353. | .54 | .70 | .457 | 2.455 | 286. | .24 | 4.22 | 132. | 85. |
| 1.68750 | 44.18 | 1.15 | 61. | 76. | 356. | .36 | .85 | .523 | 1.565 | 289. | .43 | 5.16 | -39. | 90. |
| 2.00000 | 59.28 | 1.19 | 63. | 118. | 1. | .45 | .88 | .644 | 1.635 | 290. | .38 | 7.37 | 124. | 98. |
| 2.37500 | 45.85 | 4.15 | 65. | 72. | 359. | .56 | .99 | .492 | 1.530 | 289. | .08 | 4.81 | 109. | 83. |
| 2.87500 | 42.03 | 13.19 | 71. | 69. | 7. | .37 | .76 | .276 | .896 | 284. | .43 | 2.41 | 116. | 102. |
| 3.37500 | 41.92 | 16.76 | 69. | 73. | 5. | .37 | .94 | .218 | .927 | 278. | .50 | 1.33 | 111. | 91. |
| 4.00000 | 48.82 | 22.30 | 69. | 72. | 4. | .73 | .94 | .194 | 1.036 | 283. | .44 | 1.22 | 114. | 91. |
| 4.81250 | 59.37 | 25.82 | 68. | 73. | 3. | .93 | .98 | .184 | 1.191 | 286. | .21 | 1.32 | 115. | 77. |
| 5.75000 | 62.86 | 20.37 | 70. | 79. | 4. | .95 | .97 | .164 | 1.077 | 286. | .15 | 1.21 | 117. | 80. |
| 6.81250 | 60.60 | 27.46 | 72. | 76. | 7. | .98 | .99 | .130 | .843 | 284. | .13 | .91 | 108. | 87. |
| 8.06250 | 78.74 | 42.19 | 71. | 77. | 9. | .99 | 1.00 | .121 | .799 | 285. | .12 | .89 | 99. | 72. |
| 9.52500 | 82.43 | 40.13 | 71. | 78. | 8. | .99 | .99 | .127 | .821 | 285. | .11 | 1.05 | 98. | 72. |
| 11.50000 | 112.70 | 60.97 | 70. | 71. | 210. | .86 | .25 | .305 | 1.093 | 289. | 14.26 | 7.20 | 106. | 78. |

DECOUPAGE EN 6

| FREQ | XMAX | XMIN | PHMAX | PHMIN | XOTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 147.83 | 20.38 | 63. | 69. | 231. | .07 | .03 | .780 | 1.031 | 302. | 39.67 | 26.60 | 133. | -23. |
| .35937 | 270.93 | 42.11 | 55. | -223. | 210. | .40 | .22 | 1.394 | .334 | 280. | 26.84 | 137.78 | 126. | 133. |
| .42187 | 736.34 | 30.34 | 79. | 25. | 226. | .48 | .48 | .722 | .497 | 241. | 154.11 | 51.16 | 118. | 132. |
| .50000 | 415.64 | 7.39 | 67. | 15. | 10. | .57 | .38 | .583 | .675 | 275. | 7.93 | 41.97 | 121. | 95. |
| .59375 | 340.46 | 15.42 | 17. | 104. | 208. | .41 | .48 | .812 | .436 | 300. | 14.97 | 134.56 | 113. | 104. |
| .71875 | 554.86 | 39.72 | 17. | 100. | 22. | .33 | .38 | .901 | .196 | 292. | 143.34 | 155.28 | 120. | 112. |

DOMAINE HF

DECOUPAGE EN 54

| FREQ | XMAX | XMIN | PHMAX | PHMIN | XOTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 183.84 | 54.39 | 70. | 79. | 5. | .98 | .98 | .190 | 1.030 | 279. | 1.64 | 2.64 | 113. | 88. |
| 14.0000 | 117.26 | 59.93 | 72. | 76. | 1. | .91 | 1.00 | .193 | 1.247 | 279. | 1.17 | 3.13 | 116. | 94. |
| 17.0000 | 124.11 | 82.22 | 74. | 78. | 5. | .98 | 1.00 | .172 | 1.043 | 273. | 2.31 | 2.61 | 114. | 96. |
| 20.0000 | 141.30 | 89.44 | 72. | 78. | 6. | 1.00 | 1.00 | .145 | .968 | 285. | .85 | 2.38 | 102. | 83. |
| 24.0000 | 153.22 | 91.76 | 72. | 80. | 5. | .99 | .99 | .145 | 1.129 | 282. | .72 | 2.65 | 104. | 75. |
| 29.0000 | 199.01 | 42.56 | 69. | 77. | 357. | .90 | .97 | .267 | 1.654 | 315. | .50 | 8.08 | -28. | 86. |
| 35.0000 | 196.22 | 128.28 | 71. | 78. | 6. | .99 | .99 | .137 | .908 | 284. | .88 | 2.91 | 95. | 79. |
| 41.0000 | 217.04 | 147.28 | 71. | 78. | 7. | .93 | .99 | .123 | .910 | 274. | 1.15 | 2.69 | 103. | 82. |
| 49.0000 | 215.24 | 149.15 | 73. | 74. | 344. | .97 | .91 | .113 | 1.457 | 264. | 1.15 | 2.89 | 119. | 95. |
| 58.0000 | 224.72 | 8.35 | 76. | 1. | 312. | .94 | .88 | .302 | .573 | 298. | 36.15 | 6.30 | -6. | -13. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70.0000 | 252.53 | 85.02 | 71. | 61. | 316. | .99 | .59 | .040 | .704 | 273. | 6.41 | 1.94 | -15. | -45. |
| 83.0000 | 347.09 | 194.74 | 68. | 75. | 352. | .94 | .95 | .155 | 2.470 | 279. | 1.05 | 6.31 | 116. | 84. |
| 98.0000 | 349.52 | 253.06 | 68. | 75. | 347. | .97 | .92 | .102 | 2.840 | 268. | 1.40 | 3.37 | 116. | 89. |
| 117.000 | 300.38 | 172.92 | 66. | 82. | 338. | .84 | .77 | .134 | 5.073 | 280. | 2.75 | 3.61 | -28. | 74. |

DOMAINE EF

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .08594 | 57.36 | 10.08 | 29. | 21. | 343. | .98 | .98 | .120 | 4.832 | 293. | 1.64 | .28 | -35. | 64. |
| .10156 | 52.80 | 14.53 | 28. | 31. | 347. | .99 | .93 | .133 | 2.140 | 289. | 1.58 | .51 | 133. | 44. |
| .12500 | 44.94 | 11.21 | 30. | 25. | 352. | .92 | .58 | .256 | 2.013 | 273. | 4.30 | .63 | 129. | 99. |
| .14844 | 64.89 | 8.62 | 29. | 35. | 355. | .87 | .55 | .232 | 2.068 | 271. | 9.67 | 1.00 | -44. | 118. |
| .17959 | 40.22 | 9.10 | 35. | 40. | 356. | .78 | .31 | .424 | 1.927 | 279. | 9.33 | 4.55 | 130. | 112. |
| .21094 | 57.93 | 7.21 | 38. | 15. | 356. | .60 | .16 | .409 | 1.691 | 274. | 15.49 | 8.60 | -27. | 127. |
| .25000 | 54.11 | 6.88 | 34. | 28. | 2. | .33 | .08 | .442 | 1.143 | 273. | 11.44 | 11.52 | -32. | 120. |
| .29687 | 109.60 | 4.11 | 28. | 65. | 359. | .47 | .12 | .856 | 1.386 | 294. | 73.59 | 28.92 | -37. | -44. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 115.69 | 25.34 | 53. | 36. | 340. | .87 | .89 | .136 | 0 | 306. | 4.02 | 1.17 | -11. | 81. |
| .02539 | 108.28 | 27.04 | 40. | 50. | 337. | .97 | .92 | .126 | 4.329 | 294. | 2.90 | .97 | -33. | 57. |
| .03125 | 99.10 | 25.79 | 37. | 42. | 341. | .93 | 1.00 | .166 | 5.111 | 288. | 1.54 | 1.58 | -33. | 55. |
| .03711 | 86.90 | 26.48 | 34. | 39. | 340. | .99 | .98 | .149 | 5.142 | 289. | 1.16 | 1.37 | -34. | 52. |
| .04492 | 84.00 | 22.42 | 31. | 38. | 341. | .99 | .98 | .141 | 6.456 | 293. | 1.61 | 1.26 | -34. | 49. |
| .05273 | 74.70 | 23.71 | 29. | 36. | 340. | .99 | 1.00 | .140 | 3.739 | 297. | .95 | 1.19 | -36. | 44. |
| .06250 | 67.45 | 21.22 | 28. | 33. | 343. | 1.00 | .99 | .139 | 3.351 | 294. | .90 | 1.11 | -38. | 42. |
| .07422 | 60.26 | 19.32 | 27. | 31. | 343. | 1.00 | 1.00 | .143 | 2.825 | 298. | .72 | 1.13 | -39. | 41. |
| .08984 | 52.75 | 17.06 | 26. | 28. | 344. | 1.00 | .95 | .140 | 2.755 | 301. | .62 | .86 | -39. | 41. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 110.43 | 28.50 | 58. | 47. | 342. | .97 | .72 | .597 | .639 | 298. | 13.87 | 25.97 | 88. | 87. |
| .00635 | 92.88 | 16.30 | 51. | 68. | 338. | .87 | .69 | .238 | 3.092 | 295. | 5.84 | 5.54 | -44. | 100. |
| .00781 | 73.09 | 18.32 | 54. | 60. | 345. | .90 | .95 | .255 | 4.691 | 294. | .74 | 2.36 | 1. | 65. |
| .00928 | 62.75 | 15.95 | 54. | 58. | 342. | .86 | .86 | .206 | 0 | 300. | 2.48 | 2.12 | -7. | 53. |
| .01123 | 95.75 | 14.55 | 55. | 59. | 338. | .86 | .90 | .100 | 6.255 | 305. | 5.58 | .67 | -14. | 48. |
| .01318 | 93.42 | 15.41 | 51. | 51. | 345. | .72 | .85 | .164 | 0 | 300. | 2.88 | 1.70 | -25. | 79. |
| .01562 | 100.88 | 19.14 | 48. | 54. | 337. | .82 | .84 | .121 | 6.239 | 298. | 4.19 | .64 | -19. | 57. |
| .01855 | 102.81 | 24.12 | 46. | 56. | 337. | .77 | .89 | .150 | 5.867 | 296. | 1.56 | 1.28 | -30. | 70. |
| .02246 | 101.91 | 24.18 | 44. | 51. | 338. | .95 | .95 | .146 | 7.025 | 296. | 2.39 | 1.15 | -22. | 60. |

*** STATION A11 ***

DOMAINE HF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .66750 | 35.25 | 6.67 | 96. | 4. | -5. | .34 | .63 | 1.071 | .932 | -66. | 32.02 | 7.15 | 109. | 107. |
| .81250 | 28.49 | 8.00 | 111. | 51. | 37. | .43 | .52 | .851 | .471 | -66. | 16.17 | 20.55 | -24. | -31. |
| .93750 | 15.20 | 7.57 | 113. | 51. | -5. | .26 | .26 | .831 | .807 | -67. | 12.04 | 2.49 | 127. | 126. |
| 1.18750 | 19.96 | 6.47 | 90. | 26. | -15. | .48 | .57 | .847 | 1.429 | -55. | 16.76 | 3.00 | 116. | 120. |
| 1.43750 | 27.36 | 4.63 | 90. | 42. | -18. | .55 | .66 | .554 | 1.614 | -58. | 12.25 | 1.01 | 111. | 112. |
| 1.68750 | 13.40 | 6.04 | 99. | 62. | -24. | .20 | .33 | .807 | 1.119 | -20. | 12.67 | 2.33 | 128. | 126. |
| 2.00000 | 17.91 | 3.25 | 64. | 63. | -27. | .25 | .36 | .446 | 2.616 | -19. | 4.96 | .94 | 95. | 103. |
| 2.37500 | 15.46 | 10.21 | 53. | 113. | 105. | .26 | .48 | .611 | .595 | -29. | 8.27 | 2.77 | 135. | -39. |
| 2.87500 | 14.66 | 10.76 | 57. | 86. | 85. | .29 | .46 | .552 | 3.540 | 9. | 8.20 | 2.50 | -45. | -37. |
| 3.37500 | 16.70 | 10.14 | 84. | 53. | -29. | .09 | .15 | .455 | 6.542 | -13. | 6.72 | 1.82 | 122. | 126. |
| 4.00000 | 19.13 | 6.24 | 73. | 68. | -41. | .51 | .63 | .235 | 1.391 | -18. | 1.96 | .52 | 101. | 113. |
| 4.81250 | 22.71 | 6.79 | 63. | 68. | -42. | .80 | .86 | .091 | 1.318 | -6. | 1.47 | .10 | 69. | 83. |
| 5.75000 | 23.56 | 8.13 | 64. | 73. | -45. | .78 | .91 | .075 | 1.073 | -4. | 1.11 | .08 | 66. | 85. |
| 6.81250 | 25.96 | 8.21 | 63. | 69. | -44. | .86 | .94 | .072 | 1.145 | -4. | 1.33 | .08 | 67. | 87. |
| 8.06250 | 25.69 | 10.25 | 61. | 65. | -49. | .97 | .98 | .051 | .918 | -15. | .80 | .08 | 58. | 104. |
| 9.62500 | 29.62 | 9.57 | 62. | 64. | -45. | .97 | .98 | .104 | 1.082 | -4. | 1.75 | .26 | 73. | 92. |
| 11.50000 | 30.61 | 11.32 | 61. | 64. | -47. | .96 | .81 | .075 | .974 | -7. | 1.30 | .14 | 65. | 94. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 45.04 | .56 | 51. | 44. | 53. | .57 | .21 | .856 | 1.191 | -59. | 34.57 | 15.66 | -25. | -38. |
| .35937 | 31.34 | 26.99 | -177. | 29. | 9. | .54 | .71 | 1.558 | .521 | 113. | 48.04 | 23.71 | 132. | 132. |
| .42187 | 23.59 | 1.43 | 43. | 96. | 68. | .24 | .31 | 1.187 | .950 | -68. | 29.39 | 24.05 | -35. | 130. |
| .50000 | 16.35 | 4.10 | 134. | 34. | 19. | .36 | .20 | .869 | .672 | 110. | 10.87 | 9.40 | -35. | -33. |
| .59375 | 11.71 | 3.34 | 48. | 41. | 56. | .31 | .28 | .696 | 1.047 | -68. | 6.37 | 3.25 | -19. | -26. |
| .71875 | 19.59 | 3.56 | 59. | 2. | 61. | .24 | .39 | .792 | 1.691 | -43. | 15.34 | 5.69 | -12. | -26. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 36.70 | 11.30 | 59. | 61. | -52. | .92 | .93 | .403 | .601 | 16. | 2.20 | 2.98 | 133. | -38. |
| 14.0000 | 31.98 | 14.21 | 61. | 59. | -63. | .94 | .96 | .270 | .109 | -2. | 1.48 | 1.78 | -29. | -33. |
| 17.0000 | 32.32 | 14.56 | 59. | 59. | -67. | .94 | .98 | .300 | .637 | 1. | 1.67 | 3.02 | -14. | -35. |
| 20.0000 | 34.92 | 16.30 | 57. | 59. | -61. | .96 | .97 | .337 | .332 | -2. | 1.89 | 3.33 | -41. | -43. |
| 24.0000 | 35.21 | 16.99 | 60. | 60. | 107. | .90 | .94 | .258 | .533 | 1. | 2.14 | 2.43 | -13. | -34. |
| 29.0000 | 56.51 | 24.33 | 61. | 130. | 99. | .13 | .37 | .815 | .571 | 18. | 39.84 | 18.67 | -36. | -35. |
| 35.0000 | 39.57 | 17.34 | 61. | 59. | 100. | .82 | .93 | .146 | .532 | -4. | 1.42 | .69 | -16. | -30. |
| 41.0000 | 40.94 | 18.40 | 60. | 59. | 106. | .96 | .99 | .092 | .454 | -12. | .81 | .26 | 2. | -29. |
| 49.0000 | 41.13 | 20.07 | 59. | 58. | 104. | .93 | .99 | .086 | .427 | -12. | .65 | .29 | -6. | -30. |
| 58.0000 | 72.17 | 33.34 | 39. | 57. | 35. | .96 | .85 | .480 | .432 | -5. | 14.46 | 9.46 | -37. | -35. |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70.0000 | 53.34 | 30.22 | 56. | 50. | 88. | .90 | .95 | .202 | .790 | -2. | 3.87 | 1.46 | -24. | -16. |
| 83.6000 | 54.58 | 21.89 | 60. | 58. | 99. | .59 | .83 | .141 | .624 | 4. | 2.33 | .97 | -7. | -29. |
| 93.6000 | 53.02 | 22.35 | 58. | 69. | 137. | .67 | .96 | .074 | .442 | -6. | .93 | .21 | 8. | -33. |
| 117.700 | 60.19 | 17.70 | 69. | 53. | 82. | .16 | .66 | .282 | 1.470 | 15. | 12.02 | 5.36 | -2. | -32. |

DOMAINE 8F

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .06594 | 22.52 | 3.85 | 34. | 33. | -42. | .83 | .92 | .242 | 1.168 | -47. | 2.77 | .01 | 87. | 121. |
| .10156 | 15.51 | 4.13 | 33. | 29. | -42. | .83 | .94 | .262 | 1.205 | -37. | 1.75 | .13 | 90. | 112. |
| .12500 | 14.44 | 4.72 | 33. | 23. | -38. | .78 | .93 | .409 | 1.421 | -59. | 4.03 | .41 | 95. | 115. |
| .14844 | 13.98 | 3.31 | 43. | 56. | -43. | .44 | .46 | .579 | .734 | -47. | 5.68 | .08 | 105. | 131. |
| .17969 | 13.45 | 5.54 | 21. | 113. | -67. | .17 | .24 | .914 | .273 | -58. | 5.60 | 2.55 | 117. | 131. |
| .21094 | 30.69 | 14.41 | 13. | 126. | 103. | .25 | .47 | 1.609 | .346 | -61. | 36.99 | 23.34 | 128. | 125. |
| .25000 | 34.98 | 21.79 | 15. | 119. | 102. | .26 | .23 | 1.459 | .333 | -52. | 37.81 | 24.29 | -41. | -44. |
| .29687 | 26.69 | 22.60 | 119. | 15. | 1. | .18 | .22 | 1.447 | .817 | -45. | 47.80 | 17.06 | 122. | 121. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 21.89 | 8.72 | 46. | 46. | -27. | .74 | .88 | .326 | .421 | -3. | .95 | 1.70 | 130. | 135. |
| .02539 | 32.69 | 7.91 | 45. | 40. | -49. | .86 | .97 | .168 | .791 | -8. | .86 | .07 | 90. | -41. |
| .03125 | 34.32 | 7.95 | 50. | 64. | -45. | .73 | .96 | .229 | .699 | 51. | 4.11 | .46 | 94. | 28. |
| .03711 | 29.17 | 6.50 | 36. | 33. | -53. | .82 | .99 | .102 | .612 | -50. | .65 | .05 | 88. | -42. |
| .04492 | 25.67 | 6.05 | 33. | 36. | -50. | .84 | .98 | .149 | .756 | -48. | .61 | .18 | 93. | -24. |
| .05273 | 23.99 | 6.85 | 30. | 30. | -51. | .85 | .97 | .183 | .725 | 110. | .89 | .16 | 98. | -39. |
| .06250 | 23.19 | 6.29 | 30. | 28. | -47. | .83 | .96 | .114 | .926 | -35. | .64 | .06 | 83. | -41. |
| .07422 | 20.11 | 5.53 | 29. | 26. | -49. | .89 | .91 | .111 | .860 | 52. | .92 | .01 | 86. | -2. |
| .08984 | 17.02 | 4.56 | 27. | 34. | -45. | .72 | .92 | .158 | .986 | -26. | .90 | .06 | 76. | 98. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 11.79 | 6.34 | 48. | 62. | -41. | .70 | .92 | .375 | 1.760 | 7. | .50 | 1.51 | 118. | 125. |
| .00635 | 12.17 | 4.51 | 58. | 47. | -35. | .68 | .92 | .139 | .678 | -64. | .26 | .11 | -36. | 119. |
| .00781 | 21.26 | 6.05 | 50. | 59. | -48. | .91 | .96 | .129 | .848 | -35. | .19 | .30 | 79. | 129. |
| .00928 | 17.50 | 6.72 | 55. | 54. | -58. | .97 | .98 | .147 | .379 | 38. | .07 | .24 | -36. | -19. |
| .01123 | 26.52 | 7.70 | 55. | 58. | -49. | .97 | .98 | .135 | .783 | 14. | .21 | .24 | 100. | -16. |
| .01318 | 23.96 | 7.14 | 53. | 54. | -61. | .93 | .97 | .166 | .320 | 29. | .37 | .29 | 127. | -26. |
| .01562 | 25.96 | 5.95 | 49. | 52. | -56. | .92 | .99 | .023 | .546 | 11. | .35 | .30 | 89. | 22. |
| .01855 | 27.56 | 6.95 | 48. | 53. | -64. | .88 | .96 | .127 | .254 | 43. | .18 | .35 | -38. | -9. |
| .02246 | 27.85 | 6.32 | 45. | 49. | -58. | .91 | .98 | .096 | .562 | 15. | .18 | .15 | 86. | 131. |

*** STATION A12 ***

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 96.54 | 18.04 | 92. | 103. | 183. | .33 | .39 | .965 | .758 | 92. | 67.55 | 119.79 | -37. | 134. |
| .81250 | 77.00 | 49.31 | 119. | 50. | 146. | .27 | .41 | 1.269 | .219 | 69. | 85.97 | 90.89 | 134. | 134. |
| .93750 | 496.60 | 63.18 | 51. | -309. | 174. | .28 | .65 | 1.873 | 4.966 | 96. | 921.18 | 280.16 | -27. | -31. |
| 1.15750 | 101.14 | 25.25 | 124. | 65. | 155. | .35 | .68 | .851 | .446 | 218. | 38.41 | 59.57 | -40. | -43. |
| 1.43750 | 104.43 | 50.79 | 126. | 62. | 144. | .32 | .72 | 1.007 | .304 | 199. | 42.71 | 42.71 | 126. | 126. |
| 1.68750 | 85.89 | 21.25 | 72. | 57. | 163. | .07 | .15 | .403 | .793 | 210. | 7.05 | 6.45 | -38. | 125. |
| 2.00000 | 47.22 | 22.38 | 89. | 61. | 140. | .21 | .24 | .410 | .349 | 120. | 8.09 | 8.27 | -42. | -43. |
| 2.37500 | 47.27 | 26.54 | 81. | 66. | 161. | .07 | .12 | .379 | 1.259 | 109. | 2.43 | 2.75 | -36. | 133. |
| 2.87500 | 125.31 | 37.43 | 74. | 71. | 151. | .30 | .62 | .325 | .612 | 59. | 3.35 | 2.19 | -36. | 134. |
| 3.37500 | 72.64 | 27.60 | 71. | 70. | 167. | .30 | .66 | .264 | 1.000 | 123. | 7.79 | 5.09 | -31. | -43. |
| 4.00000 | 57.93 | 41.97 | 79. | 83. | 148. | .49 | .56 | .262 | .778 | 174. | 6.10 | 6.13 | 125. | 125. |
| 4.81250 | 240.99 | 123.07 | 102. | 18. | 97. | .36 | .85 | .898 | 5.654 | 137. | 322.07 | 56.59 | 118. | 117. |
| 5.75000 | 85.29 | 56.50 | 77. | 74. | 139. | .42 | .91 | .115 | .334 | 110. | .95 | 1.25 | -30. | -26. |
| 6.81250 | 120.85 | 55.74 | 76. | 77. | 115. | .74 | .91 | .229 | 1.279 | 149. | 1.34 | 4.14 | -45. | -24. |
| 8.06250 | 115.38 | 64.83 | 77. | 74. | 130. | .48 | .97 | .105 | .663 | 184. | .42 | 1.23 | -35. | -20. |
| 9.62500 | 180.70 | 68.57 | 66. | 68. | 116. | .71 | .95 | .200 | 1.696 | 134. | 13.14 | 8.43 | 122. | -36. |
| 11.5000 | 200.08 | 79.34 | 92. | 68. | 102. | .13 | .13 | .453 | 4.422 | 129. | 66.93 | 21.36 | 117. | 124. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 2007.98 | 314.18 | -44. | 96. | 221. | .03 | .18 | 2.004 | .484 | 213. | 2129.19 | 916.63 | 126. | 120. |
| .35937 | 1247.78 | 516.69 | 37. | -276. | 218. | .12 | .34 | 4.423 | .711 | 134. | 1903.72 | 344.42 | 128. | 127. |
| .42187 | 1292.57 | 524.77 | 46. | -200. | 213. | .41 | .32 | 1.333 | .545 | 135. | 1140.65 | 50.74 | 124. | 118. |
| .50000 | 402.67 | 274.61 | -114. | 80. | 113. | .17 | .38 | 1.051 | 2.269 | 188. | 557.46 | 116.26 | -25. | -22. |
| .59375 | 57.34 | 43.51 | -119. | 17. | 137. | .21 | .20 | 23.201 | .343 | 187. | 187.81 | 170.28 | 112. | 109. |
| .71875 | 128362.4 | 57.52 | -125. | 62. | 147. | .52 | .08 | .545 | .295 | 138. | 1940.10 | 2477.08 | 99. | 110. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 324.82 | 26.27 | 73. | 89. | 185. | .99 | .99 | .540 | 4.507 | 135. | 4.88 | 38.35 | 115. | -21. |
| 14.0000 | 173.85 | 110.98 | 78. | 76. | 133. | .97 | .99 | .114 | .390 | 130. | 1.35 | 1.91 | -39. | -29. |
| 17.0000 | 208.34 | 132.50 | 75. | 77. | 138. | .97 | 1.00 | .126 | .209 | 117. | 2.20 | 2.62 | 135. | -40. |
| 20.0000 | 240.39 | 138.45 | 77. | 75. | 129. | .96 | .99 | .106 | .573 | 114. | 1.94 | 2.47 | 127. | -35. |
| 24.0000 | 296.74 | 145.74 | 73. | 82. | 121. | .95 | .95 | .325 | 1.299 | 135. | 6.22 | 14.29 | -44. | -30. |
| 29.0000 | 360.62 | 208.08 | 75. | 1. | 99. | .89 | .41 | .662 | 1.241 | 143. | 71.69 | 39.08 | 101. | 122. |
| 35.0000 | 363.61 | 195.33 | 74. | 76. | 124. | .91 | 1.00 | .162 | .852 | 127. | 3.04 | 6.42 | 129. | -31. |
| 41.0000 | 385.62 | 232.11 | 75. | 75. | 134. | .95 | .99 | .074 | .394 | 105. | 1.22 | 2.09 | 135. | -29. |
| 49.0000 | 446.20 | 189.62 | 79. | 71. | 125. | .95 | .91 | .245 | .807 | 147. | 6.11 | 18.52 | -26. | -12. |
| 58.0000 | 546.76 | 1.31 | 76. | 92. | 155. | .73 | .31 | .720 | .531 | 157. | 176.36 | 80.16 | -12. | -15. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 79.0000 | 735.88 | 42.76 | 71. | 77. | 154. | .98 | .46 | .443 | .442 | 156. | 121.64 | 57.72 | -15. | -18. |
| 88.0000 | 577.06 | 334.75 | 65. | 73. | 119. | .70 | .98 | .215 | 1.361 | 132. | 9.31 | 17.06 | 116. | 133. |
| 98.0000 | 619.94 | 355.94 | 72. | 64. | 126. | .93 | .95 | .112 | .959 | 116. | 3.06 | 7.34 | -43. | -21. |
| 117.000 | 650.24 | 312.54 | 81. | 61. | 129. | .60 | .94 | .209 | .810 | 134. | 15.17 | 13.77 | 132. | -13. |

DOMAINE 8F

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .08594 | 83.27 | 37.13 | 27. | 28. | 152. | .99 | .93 | .232 | 1.042 | 145. | 4.24 | 2.85 | -41. | -44. |
| .10156 | 75.68 | 45.40 | 46. | 20. | 128. | .85 | .78 | .407 | .594 | 137. | 7.10 | 9.40 | -37. | -27. |
| .12500 | 432.01 | 90.94 | 101. | -13. | 121. | .45 | .53 | 1.004 | .897 | 91. | 282.88 | 53.30 | 112. | 117. |
| .14844 | 139.38 | 96.45 | 84. | 12. | 140. | .26 | .16 | .900 | .733 | 138. | 123.36 | 118.76 | -42. | -41. |
| .17969 | 552.71 | 309.34 | 129. | -8. | 136. | .01 | .07 | 2.491 | .278 | 116. | 542.63 | 364.44 | -45. | -40. |
| .21094 | 504.87 | 269.19 | -154. | -14. | 138. | .04 | .04 | 5.774 | .215 | 115. | 531.25 | 365.83 | 133. | 134. |
| .25000 | 883.97 | 681.52 | -129. | 12. | 139. | .16 | .09 | 10.473 | .318 | 119. | 1094.83 | 602.81 | -44. | 135. |
| .29687 | 1585.73 | 1050.22 | -137. | -4. | 139. | .11 | .12 | 8.201 | .257 | 137. | 1535.00 | 1095.98 | -41. | -40. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 175.94 | 37.21 | 30. | 47. | 174. | .94 | .96 | .213 | 1.681 | 143. | 16.48 | 2.54 | -31. | 127. |
| .02539 | 175.85 | 43.38 | 43. | 44. | 172. | .99 | .99 | .064 | 1.454 | 149. | 4.95 | .31 | -24. | 78. |
| .03125 | 156.07 | 47.53 | 37. | 57. | 179. | .99 | .94 | .157 | 2.986 | 156. | 6.29 | 3.57 | 127. | 86. |
| .03711 | 147.26 | 48.66 | 38. | 40. | 166. | .99 | .99 | .118 | 1.133 | 132. | .78 | 1.24 | -39. | 62. |
| .04492 | 133.62 | 46.81 | 30. | 38. | 169. | 1.00 | .98 | .115 | 1.248 | 146. | .78 | 1.06 | -42. | 62. |
| .05273 | 114.32 | 49.43 | 31. | 28. | 156. | .99 | .97 | .184 | .636 | 145. | .95 | .75 | 122. | 99. |
| .06250 | 99.81 | 45.71 | 31. | 23. | 153. | .99 | .98 | .146 | .774 | 143. | .98 | .24 | -31. | -33. |
| .07422 | 91.94 | 41.39 | 23. | 23. | 131. | .93 | .98 | .176 | .543 | 146. | 1.10 | 2.54 | 123. | 133. |
| .08984 | 92.94 | 27.00 | 20. | 45. | 177. | .28 | .43 | .021 | 2.412 | 147. | 7.07 | .62 | 130. | 102. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 70.78 | 35.42 | 63. | 45. | 134. | .81 | .98 | .264 | 6.185 | 163. | 5.89 | 4.19 | 28. | 49. |
| .00635 | 74.49 | 38.40 | 55. | 53. | 172. | .81 | .99 | .195 | 1.445 | 122. | .31 | 2.06 | 95. | 78. |
| .00781 | 126.32 | 38.17 | 68. | 46. | 176. | .84 | .97 | .174 | 1.661 | 127. | 11.18 | .71 | 10. | 40. |
| .00928 | 147.59 | 42.52 | 56. | 50. | 173. | .96 | .99 | .159 | 1.598 | 141. | .94 | 1.80 | 15. | 61. |
| .01123 | 151.41 | 46.14 | 60. | 51. | 168. | .80 | .98 | .168 | .989 | 136. | 6.15 | 1.09 | 10. | 47. |
| .01318 | 156.67 | 49.22 | 54. | 48. | 166. | .93 | .95 | .161 | 1.143 | 146. | 2.05 | 2.83 | 12. | 53. |
| .01562 | 234.37 | 46.45 | 52. | 52. | 170. | .84 | .97 | .072 | 1.316 | 135. | 15.79 | .29 | -15. | -. |
| .01855 | 183.35 | 43.51 | 43. | 46. | 173. | .85 | .96 | .055 | 1.477 | 142. | 5.70 | .83 | -21. | 41. |
| .02246 | 192.66 | 50.79 | 37. | 47. | 171. | .79 | 1.00 | .111 | 1.220 | 143. | 2.54 | .77 | -44. | 70. |

*** STATION 813 ***

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 736.55 | 63.50 | -167. | 41. | 230. | .43 | .34 | .950 | .670 | 216. | 13.62 | 96.25 | -32. | 132. |
| .81250 | 825.31 | 14.95 | 68. | 92. | 199. | .42 | .64 | .758 | .750 | 191. | 23.61 | 106.99 | -40. | -22. |
| .93750 | 285.58 | 55.61 | 123. | 62. | 224. | .05 | .24 | .781 | .565 | 206. | 33.35 | 33.55 | -12. | -22. |
| 1.18750 | 509.74 | 76.92 | 125. | 63. | 213. | .40 | .79 | .679 | .171 | 211. | 71.36 | 67.04 | -25. | -22. |
| 1.43750 | 311.69 | 49.12 | 118. | 54. | 230. | .17 | .51 | .507 | .889 | 206. | 7.18 | 3.95 | 6. | -44. |
| 1.68750 | 215.76 | 73.25 | 99. | 57. | 225. | .30 | .47 | .740 | .630 | 208. | 52.51 | 45.05 | -11. | -17. |
| 2.00000 | 310.47 | 61.85 | 133. | 64. | 219. | .29 | .34 | .848 | .625 | 210. | 19.95 | 21.44 | -14. | -19. |
| 2.37500 | 82.87 | 26.26 | 84. | 108. | 183. | .20 | .42 | .726 | .933 | 210. | 3.37 | 11.57 | -24. | -1. |
| 2.87500 | 85.30 | 21.46 | 76. | 90. | 189. | .12 | .30 | .538 | 1.422 | 206. | 6.39 | 5.50 | 116. | -41. |
| 3.37500 | 131.89 | 41.55 | 106. | 72. | 207. | .07 | .29 | .533 | .536 | 208. | 6.37 | 7.18 | -22. | -9. |
| 4.00000 | 142.71 | 98.28 | 94. | 65. | 243. | .17 | .55 | .507 | 1.575 | 210. | 26.52 | 27.01 | -10. | -23. |
| 4.81250 | 154.14 | 71.56 | 82. | 73. | 211. | .02 | .66 | .242 | .518 | 207. | 2.83 | 3.94 | -14. | -10. |
| 5.75000 | 115.86 | 69.53 | 79. | 75. | 204. | .40 | .67 | .211 | .559 | 210. | 1.77 | 2.33 | -35. | -25. |
| 6.81250 | 112.63 | 99.23 | 77. | 75. | 214. | .48 | .95 | .167 | .579 | 213. | 2.61 | 2.89 | -7. | -7. |
| 8.06250 | 126.30 | 107.25 | 77. | 74. | 241. | .79 | .98 | .160 | 1.228 | 216. | 4.24 | 2.97 | -6. | -9. |
| 9.62500 | 132.52 | 114.30 | 76. | 74. | 209. | .67 | .95 | .158 | .477 | 214. | 2.73 | 3.10 | -9. | -9. |
| 11.5000 | 152.18 | 127.14 | 73. | 74. | 195. | .10 | .76 | .160 | .897 | 213. | 2.35 | 3.57 | -8. | -9. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 34.44 | 30.24 | -143. | 17. | 213. | .23 | .28 | 3.282 | .096 | 208. | 20.51 | 15.61 | 134. | 133. |
| .35937 | 165.73 | 41.30 | -175. | 43. | 217. | .37 | .78 | .961 | .490 | 199. | 10.91 | 10.72 | -4. | -6. |
| .42187 | 440.16 | 26.01 | -173. | 35. | 221. | .33 | .19 | .980 | .728 | 210. | 5.75 | 17.38 | 134. | 127. |
| .50000 | 103.95 | 23.10 | 73. | 39. | 232. | .20 | .47 | .676 | .908 | 213. | 7.55 | 16.11 | 119. | 108. |
| .59375 | 156.21 | 12.29 | 92. | 21. | 245. | .16 | .26 | .597 | 1.104 | 219. | 17.64 | 30.21 | -24. | 126. |
| .71875 | 631.51 | 20.05 | 108. | 56. | 225. | .06 | .31 | .225 | .343 | 218. | 15.93 | 24.52 | -27. | 131. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 170.44 | 130.48 | 80. | 72. | 205. | .98 | .88 | .263 | 1.692 | 174. | 15.83 | 15.69 | -32. | -30. |
| 14.0000 | 193.66 | 157.55 | 78. | 73. | 217. | .98 | .91 | .370 | .650 | 202. | 27.01 | 26.90 | -22. | -22. |
| 17.0000 | 218.42 | 184.15 | 80. | 76. | 221. | .92 | .93 | .288 | 1.216 | 167. | 23.61 | 23.56 | -25. | -25. |
| 20.0000 | 240.72 | 208.72 | 75. | 75. | 217. | .96 | .94 | .217 | 1.193 | 203. | 12.63 | 12.49 | -22. | -22. |
| 24.0000 | 262.27 | 194.52 | 77. | 69. | 197. | .87 | .91 | .230 | 1.889 | 201. | 15.64 | 17.80 | -34. | -28. |
| 29.0000 | 411.67 | 2.67 | 79. | 17. | 183. | .71 | .19 | .470 | 2.239 | 205. | 192.40 | 26.92 | 89. | 96. |
| 35.0000 | 385.02 | 196.19 | 80. | 60. | 187. | .94 | .83 | .180 | 2.277 | 206. | 34.42 | 17.95 | 121. | 135. |
| 41.0000 | 393.74 | 320.03 | 73. | 71. | 219. | .96 | .96 | .205 | .424 | 204. | 16.28 | 15.53 | -13. | -14. |
| 49.0000 | 629.89 | 317.76 | 68. | 66. | 211. | .79 | .97 | .159 | .571 | 186. | 9.82 | 14.09 | -29. | -27. |
| 58.0000 | 1515.77 | 218.46 | 43. | 56. | 214. | .97 | .89 | .111 | .875 | 141. | 65.34 | 68.66 | 112. | 115. |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70.0000 | 1062.66 | 360.09 | 48. | 56. | 212. | .92 | .92 | .060 | 1.087 | 138. | 59.06 | 64.19 | 114. | 118. |
| 83.0000 | 612.73 | 310.04 | 77. | 60. | 196. | .91 | .77 | .206 | 1.037 | 208. | 44.21 | 26.93 | 122. | 134. |
| 96.0000 | 681.76 | 337.17 | 75. | 61. | 197. | .92 | .80 | .186 | .939 | 206. | 35.76 | 25.32 | 123. | -43. |
| 117.000 | 790.53 | 283.93 | 72. | 60. | 189. | .91 | .84 | .141 | 1.467 | 207. | 41.48 | 21.03 | 106. | 132. |

DOMAINE 8F

DECOUPAGE EN 48

| FREQ | KMAX | KMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02594 | 46.93 | 24.15 | 31. | 47. | 164. | .57 | .92 | .397 | 1.265 | 210. | 2.19 | 6.24 | -14. | -18. |
| .10156 | 46.16 | 30.16 | 92. | 26. | 226. | .47 | .84 | .538 | .556 | 210. | 3.73 | 5.29 | -19. | -35. |
| .12500 | 127.19 | 50.21 | -142. | 19. | 220. | .42 | .73 | 2.377 | .139 | 203. | 32.78 | 47.82 | -34. | -36. |
| .14844 | 40.77 | 24.94 | -173. | 22. | 221. | .04 | .18 | 1.468 | .349 | 211. | 7.09 | 12.37 | -42. | -44. |
| .17969 | 97.82 | 34.51 | -174. | 12. | 210. | .12 | .12 | 1.727 | .420 | 207. | 43.03 | 25.52 | 124. | 123. |
| .21094 | 99.82 | 47.32 | -111. | 26. | 231. | .07 | .15 | 4.317 | .667 | 212. | 24.59 | 62.32 | 115. | 128. |
| .25000 | 118.73 | 56.39 | -177. | 22. | 222. | .12 | .15 | 1.592 | .201 | 210. | 50.76 | 72.13 | -41. | -44. |
| .29687 | 147.43 | 30.62 | -141. | 32. | 219. | .04 | .04 | 1.663 | .259 | 209. | 25.50 | 35.44 | -38. | -38. |

DECOUPAGE EN 12

| FREQ | KMAX | KMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 113.63 | 30.02 | 50. | 34. | 172. | .72 | 1.00 | .074 | 0 | 216. | 6.74 | .54 | 83. | -43. |
| .02539 | 88.23 | 55.39 | 47. | 36. | 171. | .75 | .95 | .254 | 3.012 | 212. | 4.34 | 5.74 | 123. | -43. |
| .03125 | 76.57 | 49.23 | 51. | 58. | 158. | .91 | .94 | .371 | .561 | 197. | 5.25 | 7.75 | -36. | -15. |
| .03711 | 78.76 | 50.23 | 46. | 34. | 156. | .92 | .98 | .195 | 1.963 | 229. | 1.43 | 2.29 | 126. | -33. |
| .04492 | 67.58 | 47.56 | 37. | 28. | 168. | 1.00 | 1.00 | .176 | 0 | 226. | 1.12 | 1.71 | 125. | -33. |
| .05273 | 69.09 | 43.14 | 30. | 31. | 175. | .86 | .99 | .250 | 3.963 | 209. | .99 | 3.46 | -27. | -32. |
| .06250 | 57.07 | 43.43 | 24. | 34. | 167. | .68 | .99 | .183 | 4.046 | 218. | 1.07 | 1.65 | -11. | -35. |
| .07422 | 63.58 | 29.71 | 26. | 37. | 169. | .89 | .98 | .182 | 4.150 | 213. | 1.18 | 1.94 | 19. | -13. |
| .08984 | 81.00 | 19.11 | 27. | 36. | 169. | .49 | .94 | .343 | 0 | 216. | .59 | 4.34 | 2. | -26. |

DECOUPAGE EN 3

| FREQ | KMAX | KMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 92.44 | 27.20 | 70. | 33. | 185. | .85 | .99 | .406 | 2.071 | 179. | 2.18 | 1.52 | 73. | 9. |
| .00635 | 75.92 | 27.30 | 49. | 61. | 179. | .94 | .88 | .077 | 2.253 | 205. | 2.66 | .99 | 71. | 118. |
| .00781 | 89.72 | 31.36 | 45. | 62. | 175. | .91 | .99 | .151 | 5.417 | 224. | 1.87 | 1.63 | 70. | 127. |
| .00928 | 75.64 | 24.54 | 59. | 60. | 168. | .79 | .99 | .109 | 7.896 | 232. | 2.06 | .67 | 64. | 10. |
| .01123 | 83.14 | 26.82 | 57. | 42. | 171. | .81 | .97 | .107 | 5.414 | 209. | 2.46 | .25 | 74. | 1. |
| .01318 | 85.66 | 32.13 | 53. | 49. | 167. | .72 | 1.00 | .080 | 4.699 | 217. | 2.19 | .17 | 65. | -2. |
| .01562 | 99.90 | 33.43 | 49. | 42. | 176. | .86 | .98 | .113 | 2.891 | 218. | 2.41 | .29 | 66. | -23. |
| .01855 | 107.66 | 39.02 | 47. | 52. | 172. | .85 | .99 | .087 | 0 | 218. | 2.76 | .39 | 55. | -10. |
| .02246 | 107.07 | 44.61 | 45. | 49. | 178. | .90 | 1.00 | .042 | 3.833 | 220. | 2.45 | .11 | 59. | -10. |

*** STATION 814 ***

DOMAINE BF

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .06594 | 51.12 | 17.70 | 25. | 57. | 81. | .94 | .98 | .366 | .592 | 1. | 9.65 | 4.87 | -42. | 130. |
| .10156 | 39.73 | 16.05 | 24. | 62. | 69. | .76 | .85 | .282 | .385 | 4. | 4.40 | 1.81 | 125. | 127. |
| .12500 | 39.06 | 15.09 | 66. | 19. | -41. | .71 | .67 | .730 | 1.101 | 6. | 35.43 | 3.00 | 105. | 84. |
| .14844 | 38.19 | 23.76 | 17. | 87. | 85. | .20 | .32 | .826 | 1.100 | 5. | 39.74 | 7.93 | 116. | 130. |
| .17969 | 76.33 | 20.95 | 17. | 136. | 83. | .29 | .21 | 1.354 | .657 | 4. | 76.89 | 29.51 | 133. | -43. |
| .21094 | 91.48 | 16.85 | 16. | 122. | 86. | .12 | .19 | 1.349 | .437 | 5. | 73.44 | 43.14 | -40. | 134. |
| .25000 | 98.19 | 27.96 | 31. | 13. | 87. | .13 | .14 | 1.517 | .676 | 8. | 113.49 | 28.36 | 126. | 135. |
| .29687 | 150.48 | 45.33 | 2. | -310. | 84. | .11 | .12 | 3.129 | .580 | 8. | 180.90 | 74.77 | -41. | -42. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 85.32 | 23.49 | 45. | 51. | -76. | .94 | .98 | .131 | .410 | -8. | 2.29 | .45 | 118. | -12. |
| .02539 | 94.23 | 32.49 | 40. | 46. | -95. | .98 | 1.00 | .113 | .238 | -3. | 1.82 | .48 | 130. | -36. |
| .03125 | 84.59 | 32.73 | 38. | 40. | -76. | 1.00 | 1.00 | .113 | .422 | -13. | 2.37 | .02 | 103. | 108. |
| .03711 | 76.88 | 31.46 | 33. | 39. | -93. | .99 | 1.00 | .079 | .272 | -13. | 1.02 | .27 | -45. | -30. |
| .04492 | 71.56 | 24.90 | 29. | 44. | -97. | 1.00 | .99 | .069 | .317 | -4. | .94 | .07 | 115. | -24. |
| .05273 | 64.27 | 28.20 | 26. | 36. | -79. | .99 | .99 | .069 | .255 | 2. | .57 | .07 | 110. | -30. |
| .06250 | 56.43 | 26.11 | 26. | 36. | -98. | .99 | .97 | .094 | .335 | 5. | .99 | .12 | 115. | -36. |
| .07422 | 50.00 | 25.38 | 25. | 35. | -97. | .99 | .97 | .059 | .213 | 2. | .33 | .08 | -9. | -39. |
| .08984 | 42.47 | 21.25 | 23. | 33. | -76. | .93 | .96 | .124 | .542 | 7. | 1.53 | .04 | 105. | -37. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 54.65 | 16.49 | 56. | 36. | -48. | .95 | .82 | .158 | 2.462 | -76. | 1.65 | 1.85 | 73. | 23. |
| .00635 | 65.23 | 22.11 | 57. | 51. | -58. | .98 | .98 | .082 | .940 | -7. | 1.86 | .59 | 70. | 36. |
| .00781 | 76.67 | 18.71 | 56. | 56. | -63. | .97 | .99 | .045 | .741 | -41. | 2.30 | .08 | 68. | 44. |
| .00928 | 73.40 | 22.08 | 53. | 54. | -67. | .99 | .99 | .044 | .574 | -11. | 1.54 | .20 | 65. | 98. |
| .01123 | 80.74 | 24.30 | 54. | 51. | -69. | .98 | 1.00 | .076 | .468 | -24. | 1.53 | .26 | 62. | 48. |
| .01318 | 82.75 | 28.40 | 50. | 55. | -82. | .99 | 1.00 | .100 | .925 | -1. | 4.10 | .52 | 63. | 75. |
| .01562 | 87.15 | 31.75 | 48. | 52. | -66. | .99 | 1.00 | .077 | .472 | 4. | 1.89 | .36 | 66. | 70. |
| .01855 | 90.42 | 30.91 | 46. | 49. | -70. | 1.00 | 1.00 | .073 | .434 | 6. | 1.74 | .15 | 50. | 60. |
| .02246 | 88.64 | 32.93 | 43. | 48. | -71. | 1.00 | 1.00 | .055 | .401 | 7. | 1.23 | .10 | 52. | 62. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 151.26 | 81.74 | 105. | 2. | -33. | .22 | .19 | 1.509 | 2.870 | 12. | 340.06 | 84.69 | 114. | 108. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .81250 | 99.73 | 75.38 | 90. | -12. | -31. | .70 | .45 | 1.376 | 1.937 | 9. | 223.69 | 44.67 | 109. | 101. |
| .93750 | 241.22 | 50.72 | 17. | 118. | 64. | .98 | .49 | 1.344 | 2.074 | 11. | 358.65 | 133.80 | 132. | 127. |
| 1.18750 | 166.79 | 94.38 | 16. | 120. | 83. | .49 | .24 | 1.551 | 3.712 | 11. | 386.80 | 166.14 | 124. | 126. |
| 1.43750 | 266.77 | 41.65 | 46. | 129. | 67. | .56 | .43 | .895 | 2.296 | 3. | 251.68 | 56.13 | -39. | -36. |
| 1.68750 | 113.81 | 66.38 | 37. | 122. | 65. | .36 | .25 | 1.196 | 3.470 | 6. | 211.93 | 57.47 | 135. | -40. |
| 2.00000 | 174.04 | 70.35 | 109. | 23. | -41. | .11 | .12 | 1.112 | 2.444 | 8. | 279.81 | 44.15 | 122. | 113. |
| 2.37500 | 161.48 | 59.63 | 65. | 92. | 85. | .33 | .22 | .843 | 1.689 | -2. | 182.03 | 35.47 | -42. | -24. |
| 2.87500 | 107.33 | 64.47 | 105. | 42. | -46. | .08 | .07 | .835 | 2.587 | 1. | 144.60 | 15.17 | 127. | 119. |
| 3.37500 | 127.95 | 28.19 | 54. | 135. | 60. | .67 | .31 | .632 | 3.846 | 2. | 83.84 | 25.06 | -33. | -35. |
| 4.00000 | 132.08 | 47.78 | 92. | 48. | -45. | .61 | .17 | .713 | 2.112 | 6. | 110.05 | 18.92 | 115. | 105. |
| 4.81250 | 109.01 | 41.51 | 65. | 60. | -62. | .64 | .40 | .475 | 1.770 | 1. | 52.39 | 1.51 | 124. | 117. |
| 5.75000 | 94.69 | 53.62 | 67. | 89. | 69. | .75 | .41 | .279 | 2.631 | -2. | 18.52 | 3.28 | -39. | -37. |
| 6.84250 | 105.99 | 75.55 | 75. | 70. | -69. | .92 | .72 | .263 | 2.439 | -2. | 19.46 | .60 | 125. | 114. |
| 8.06250 | 109.53 | 80.17 | 83. | 73. | -54. | .97 | .86 | .155 | 2.139 | 12. | 6.79 | 1.56 | 111. | 103. |
| 9.62500 | 114.41 | 88.62 | 77. | 77. | -75. | .93 | .82 | .119 | 1.097 | -7. | 3.61 | .24 | 124. | 120. |
| 11.5000 | 176.31 | 97.11 | 79. | 67. | -57. | .46 | .26 | .286 | 1.819 | -6. | 29.76 | 2.88 | 120. | 124. |

DECOUPAGE EN 6

| FREQ | XMAX | XMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 816.49 | 34.42 | 53. | -196. | 82. | .53 | .43 | 1.067 | 1.730 | 7. | 875.08 | 292.51 | -14. | -35. |
| .35937 | 293.66 | 124.52 | -23. | 113. | 71. | .33 | .20 | 2.394 | 1.241 | 11. | 615.35 | 226.78 | 119. | 114. |
| .42187 | 1105.54 | 913.68 | -19. | 122. | 73. | .28 | .36 | 2.928 | 1.522 | 11. | 3279.98 | 831.32 | 113. | 124. |
| .50000 | 209.78 | .37 | 49. | -28. | 61. | .06 | .09 | .964 | 3.268 | 13. | 195.26 | 53.62 | -21. | -30. |
| .59375 | 564.49 | 250.10 | -13. | 16. | 75. | .39 | .25 | 4.164 | 1.025 | 9. | 1144.93 | 416.65 | 130. | 119. |
| .71875 | 148.08 | 55.62 | 21. | 131. | 74. | .10 | .13 | 1.477 | 1.330 | 12. | 232.47 | 66.53 | 128. | 128. |

DOMAINE HF

DECOUPAGE EN 46

| FREQ | XMAX | XMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 186.23 | 93.90 | 80. | 67. | -55. | .85 | .81 | .303 | 1.814 | -11. | 35.40 | 5.33 | 116. | 115. |
| 14.5000 | 172.59 | 90.49 | 77. | 75. | -58. | .83 | .93 | .084 | 1.040 | -16. | 3.96 | .85 | 98. | 114. |
| 17.5000 | 235.77 | 99.57 | 82. | 67. | -47. | .88 | .95 | .277 | 2.692 | -9. | 41.32 | 9.25 | 104. | 102. |
| 20.5000 | 273.44 | 142.89 | 72. | 82. | -53. | .95 | .99 | .197 | 1.639 | -7. | 11.15 | 10.29 | 94. | 116. |
| 24.5000 | 317.09 | 133.13 | 81. | 71. | -44. | .92 | .93 | .287 | 3.118 | -4. | 55.53 | 14.85 | 99. | 97. |
| 29.0000 | 275.46 | 2.67 | 76. | 23. | -78. | .06 | .97 | .304 | .171 | 29. | 5.66 | 12.82 | 95. | 115. |
| 35.0000 | 345.31 | 196.22 | 77. | 76. | -55. | .90 | .98 | .107 | 1.378 | -19. | 12.26 | 2.63 | 94. | 96. |
| 41.5000 | 391.14 | 243.75 | 79. | 74. | -50. | .95 | .96 | .147 | 2.058 | -12. | 21.43 | 5.67 | 98. | 94. |
| 49.0000 | 433.51 | 264.20 | 80. | 73. | -47. | .96 | .95 | .158 | 2.878 | 14. | 29.26 | 6.79 | 101. | 98. |
| 58.5000 | 1085.66 | 433.22 | 41. | 75. | 19. | .95 | .63 | .242 | 1.100 | 89. | 204.77 | 135.19 | 127. | 124. |
| 70.0000 | 593.76 | 426.13 | 82. | 68. | -45. | .92 | .86 | .145 | 4.944 | -17. | 39.31 | 6.36 | 114. | 115. |
| 83.0000 | 574.92 | 170.20 | 74. | 76. | -64. | .53 | .94 | .143 | .670 | -3. | 29.89 | 6.19 | 93. | 102. |
| 99.0000 | 684.63 | 426.96 | 78. | 74. | -49. | .91 | .97 | .116 | 1.968 | -2. | 28.46 | 4.28 | 102. | 97. |
| 117.500 | 704.37 | 163.40 | 74. | 85. | -64. | .48 | .92 | .073 | .686 | 14. | 28.92 | 1.44 | 70. | 77. |

*** STATION B15 ***

DOMAINE HF

DECOUPAGE EN 48

| FREQ | XMAX | XMIN | PHMAX | PHMIN | XOTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .05594 | 110.86 | 20.27 | 22. | 52. | 91. | .74 | .89 | .461 | .335 | -3. | 20.37 | 13.17 | -26. | -41. |
| .10156 | 94.84 | 32.19 | 24. | 46. | 89. | .56 | .89 | .392 | .439 | -3. | 14.67 | 8.68 | -39. | -32. |
| .12500 | 85.91 | 30.67 | 23. | 63. | 83. | .52 | .65 | .496 | .657 | 1. | 25.67 | 12.94 | -43. | -37. |
| .14144 | 85.96 | 33.56 | 24. | 65. | 94. | .51 | .72 | .408 | .406 | 3. | 12.99 | 8.63 | -44. | -28. |
| .17969 | 88.15 | 34.38 | 26. | 63. | 87. | .21 | .38 | .596 | .444 | 3. | 25.65 | 14.73 | -44. | -38. |
| .21094 | 83.43 | 30.12 | 25. | 109. | 94. | .17 | .26 | .706 | .274 | 3. | 17.56 | 17.81 | -30. | 130. |
| .25000 | 76.83 | 31.60 | 22. | 127. | 98. | .12 | .16 | 1.338 | .159 | 5. | 31.34 | 38.23 | -40. | -41. |
| .29687 | 72.55 | 30.95 | 15. | 13. | 99. | .13 | .23 | 1.542 | .149 | 5. | 25.60 | 24.01 | 135. | -34. |

DECOUPAGE EN 12

| FREQ | XMAX | XMIN | PHMAX | PHMIN | XOTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 192.54 | 35.15 | 58. | 43. | 88. | .93 | .99 | .052 | .502 | -18. | 5.33 | .95 | -7. | 129. |
| .02539 | 165.83 | 35.33 | 45. | 45. | 87. | .96 | 1.00 | .059 | .451 | -23. | 3.16 | 1.94 | -14. | 120. |
| .03125 | 164.91 | 38.49 | 43. | 44. | 85. | .89 | .96 | .083 | .526 | -13. | 5.55 | 1.47 | -23. | 131. |
| .03711 | 176.92 | 42.71 | 39. | 41. | 87. | .93 | .96 | .076 | .482 | -12. | 4.25 | 1.86 | -20. | 126. |
| .04492 | 162.13 | 40.74 | 35. | 39. | 89. | .97 | .98 | .135 | .423 | -17. | 4.31 | 3.90 | -28. | 124. |
| .05273 | 154.54 | 43.55 | 32. | 38. | 88. | .96 | .97 | .136 | .468 | -7. | 4.58 | 3.88 | -27. | 122. |
| .06250 | 141.08 | 42.34 | 26. | 41. | 89. | .96 | .95 | .138 | .351 | -12. | 3.60 | 3.06 | -42. | 118. |
| .07422 | 141.96 | 38.52 | 25. | 39. | 89. | .90 | .93 | .134 | .369 | -12. | 4.01 | 1.83 | 131. | 115. |
| .08984 | 109.73 | 38.42 | 20. | 37. | 90. | .70 | .95 | .196 | .249 | -5. | 3.62 | 2.91 | -43. | -26. |

DECOUPAGE EN 3

| FREQ | XMAX | XMIN | PHMAX | PHMIN | XOTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 124.14 | 29.64 | 20. | 54. | 92. | .94 | .97 | .218 | .234 | -22. | 5.49 | 3.06 | -39. | -43. |
| .00635 | 99.12 | 31.65 | 69. | 56. | 89. | 1.00 | .87 | .100 | .531 | -. | .86 | 2.20 | -8. | 128. |
| .00781 | 134.07 | 26.52 | 58. | 56. | 86. | .93 | .97 | .078 | .492 | 19. | 2.43 | .13 | 2. | 36. |
| .00928 | 117.75 | 31.70 | 58. | 55. | 97. | .98 | .95 | .091 | .141 | 2. | .94 | .68 | -10. | -30. |
| .01123 | 152.61 | 35.56 | 53. | 55. | 89. | .98 | .99 | .050 | .306 | 10. | 2.01 | .21 | -10. | 15. |
| .01318 | 164.57 | 39.78 | 55. | 52. | 91. | .99 | .99 | .039 | .230 | -4. | 1.25 | .11 | -6. | 11. |
| .01562 | 156.79 | 41.19 | 54. | 50. | 99. | .99 | .99 | .050 | .398 | -1. | 2.36 | .07 | -5. | -1. |
| .01855 | 194.74 | 42.55 | 50. | 51. | 88. | .99 | .99 | .042 | .434 | -27. | 3.27 | .03 | -8. | -29. |
| .02246 | 191.26 | 40.34 | 49. | 49. | 88. | .99 | 1.00 | .044 | .403 | -36. | 3.11 | .08 | -8. | -23. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | XMAX | XMIN | PHMAX | PHMIN | XOTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .68750 | 782.08 | 513.98 | 119. | 23. | 5. | .60 | .55 | 1.466 | .497 | 3. | 1113.31 | 961.73 | 134. | 135. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .81250 | 323.05 | 166.76 | -174. | 11. | -. | .56 | .34 | 1.941 | .308 | -18. | 304.06 | 171.65 | 132. | 133. |
| .93750 | 172.62 | 115.04 | -178. | 8. | 9. | .35 | .22 | 1.895 | .206 | 8. | 142.37 | 142.37 | -34. | -34. |
| 1.18750 | 156.32 | 31.29 | 67. | 32. | 33. | .15 | .16 | 1.137 | .613 | 5. | 175.35 | 230.79 | -29. | -38. |
| 1.43750 | 328.37 | 30.32 | 70. | 94. | 91. | .20 | .22 | .752 | 3.001 | -4. | 195.46 | 115.83 | -30. | -44. |
| 1.68750 | 146.48 | 90.81 | 67. | 20. | -1. | .32 | .26 | .720 | 1.146 | 5. | 112.12 | 96.68 | 130. | 134. |
| 2.00000 | 125.72 | 45.63 | 109. | 31. | -7. | .17 | .08 | .892 | .718 | 6. | 87.55 | 49.85 | 133. | -40. |
| 2.37500 | 230.66 | 26.68 | 75. | 52. | 37. | .20 | .11 | .852 | .906 | -3. | 152.26 | 154.83 | -31. | -43. |
| 2.87500 | 221.04 | 11.16 | 73. | 38. | 52. | .14 | .11 | .687 | 2.716 | 4. | 175.96 | 84.22 | -15. | -29. |
| 3.37500 | 143.33 | 45.99 | 72. | 71. | 47. | .25 | .22 | .713 | .901 | 4. | 78.94 | 84.05 | -30. | -41. |
| 4.00000 | 244.15 | 35.83 | 74. | 98. | 56. | .23 | .24 | .730 | 5.841 | 8. | 154.53 | 67.81 | -24. | -33. |
| 4.81250 | 106.33 | 32.36 | 70. | 77. | 50. | .30 | .23 | .458 | 1.619 | 5. | 27.80 | 24.13 | -34. | 132. |
| 5.75000 | 142.47 | 21.60 | 67. | 57. | 46. | .08 | .05 | .351 | 3.651 | 6. | 27.27 | 8.38 | -24. | -44. |
| 6.81250 | 98.85 | 94.29 | 65. | 77. | 23. | .70 | .63 | .218 | .973 | 4. | 7.20 | 5.37 | -39. | -36. |
| 8.06250 | 125.31 | 61.70 | 72. | 72. | 52. | .92 | .67 | .136 | 0 | 8. | 5.32 | 1.86 | -21. | -30. |
| 9.62500 | 135.44 | 64.34 | 75. | 68. | 54. | .75 | .74 | .106 | 7.937 | 6. | 5.38 | 1.13 | -7. | -15. |
| 11.5000 | 146.9[illegible] | 70.34 | 69. | 75. | 43. | .70 | .47 | .077 | 2.239 | 3. | 5.17 | .35 | -25. | -44. |

DECOUPAGE EN 6

| FREQ | KMAX | KMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 172.66 | 94.22 | 6. | 71. | 90. | .35 | .80 | .922 | .423 | 1. | 139.80 | 74.16 | 110. | 111. |
| .35937 | 265.41 | 107.67 | 51. | 110. | 56. | .43 | .65 | .837 | .996 | 10. | 242.53 | 261.28 | 130. | 120. |
| .42187 | 142.23 | 59.73 | -145. | 26. | 5. | .29 | .42 | 2.623 | .226 | 8. | 139.49 | 120.98 | -15. | -12. |
| .50000 | 138.09 | 29.01 | 69. | 19. | 34. | .18 | .12 | 1.189 | 1.077 | 6. | 163.13 | 83.67 | 2. | 2. |
| .59375 | 446.26 | 166.13 | 115. | 65. | 4. | .26 | .13 | .864 | .383 | 7. | 261.45 | 261.45 | 132. | 132. |
| .71875 | 266.37 | 60.37 | -163. | 21. | -2. | .27 | .09 | 1.499 | .514 | 12. | 206.94 | 131.55 | -33. | -26. |

DOMAINE HF

DECOUPAGE EN 54

| FREQ | KMAX | KMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 241.60 | 49.39 | 73. | 68. | 49. | .68 | .74 | .367 | 5.104 | -6. | 47.03 | 13.76 | -23. | -39. |
| 14.0000 | 245.92 | 67.29 | 75. | 72. | 52. | .66 | .60 | .308 | 0 | 2. | 36.63 | 12.50 | -23. | -41. |
| 17.0000 | 276.71 | 66.81 | 67. | 74. | 54. | .61 | .68 | .343 | 4.471 | -2. | 63.53 | 25.47 | -25. | -39. |
| 20.0000 | 283.54 | 65.38 | 66. | 74. | 56. | .91 | .71 | .363 | 6.353 | -21. | 66.60 | 25.88 | -27. | -38. |
| 24.0000 | 276.30 | 76.45 | 60. | 68. | 45. | .74 | .38 | .463 | 2.585 | -8. | 96.24 | 59.36 | -43. | 125. |
| 29.0000 | 396.44 | 4.35 | 65. | 41. | 54. | .36 | .36 | .574 | 3.796 | 9. | 240.13 | 52.57 | -20. | -38. |
| 35.0000 | 333.10 | 60.33 | 67. | 70. | 53. | .73 | .78 | .260 | 0 | 4. | 86.64 | 13.42 | -20. | -28. |
| 41.6000 | 394.85 | 140.14 | 67. | 75. | 54. | .79 | .87 | .256 | 5.251 | -3. | 60.35 | 21.65 | -26. | -38. |
| 49.0000 | 380.02 | 187.38 | 75. | 69. | 52. | .88 | .89 | .227 | 5.997 | -4. | 40.80 | 16.26 | -18. | -28. |
| 58.1000 | 763.59 | 77.75 | 48. | 66. | 12. | .80 | .47 | .377 | .270 | 8. | 54.33 | 65.19 | 91. | 88. |
| 70.0000 | 446.93 | 365.53 | 64. | 67. | 66. | .86 | .83 | .164 | 1.783 | -7. | 21.51 | 7.92 | -33. | -25. |
| 83.6000 | 656.52 | 4.32 | 67. | 67. | 54. | .52 | .66 | .435 | 0 | 7. | 313.73 | 36.43 | -11. | -14. |
| 98.0000 | 531.24 | 65.74 | 61. | 57. | 58. | .68 | .75 | .307 | 6.663 | 4. | 157.40 | 26.86 | -10. | -17. |
| 117.000 | 597.95 | 19.97 | 71. | 11. | 57. | .55 | .59 | .464 | 7.262 | 8. | 304.85 | 38.21 | -3. | -5. |

*** STATION 816 ***

DOMAINE BF

DECOUPAGE EN 48

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .06594 | 99.48 | 51.24 | 85. | 29. | 142. | .78 | .59 | .803 | .384 | 124. | 54.51 | 80.70 | -37. | -44. |
| .10156 | 99.46 | 64.27 | 74. | 19. | 127. | .49 | .82 | .824 | .313 | 127. | 60.87 | 61.91 | -40. | -41. |
| .12500 | 500.85 | 309.51 | 25. | 1. | 215. | .33 | .19 | 1.606 | .046 | 124. | 360.96 | 344.32 | -44. | -42. |
| .14844 | 641.14 | 403.92 | 35. | -294. | 42. | .20 | .22 | 4.824 | .221 | 126. | 406.48 | 360.88 | 116. | 125. |
| .17969 | 1475.51 | 655.68 | 28. | -319. | 215. | .20 | .19 | 3.752 | .072 | 126. | 1188.04 | 1156.55 | -40. | -43. |
| .21094 | 845.23 | 843.15 | -141. | 31. | 126. | .15 | .09 | 3.378 | .058 | 121. | 929.26 | 929.26 | 134. | 134. |
| .25000 | 2079.73 | 1487.13 | 4. | -312. | 38. | .23 | .11 | 12.019 | .120 | 124. | 1614.46 | 1804.11 | 135. | -39. |
| .29687 | 1867.10 | 614.36 | -. | -313. | 215. | .07 | .11 | 3.538 | .099 | 124. | 1077.63 | 1151.63 | -42. | -37. |

DECOUPAGE EN 12

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .02148 | 177.11 | 20.49 | 49. | 34. | 169. | .96 | .96 | .042 | 6.437 | 127. | 16.96 | .53 | -17. | 101. |
| .02539 | 203.09 | 28.61 | 39. | 48. | 166. | .91 | .94 | .046 | 5.666 | 133. | 18.40 | .04 | -26. | 38. |
| .03125 | 203.95 | 26.89 | 40. | 32. | 166. | .94 | .94 | .086 | 4.531 | 92. | 20.19 | 1.77 | -28. | 108. |
| .03711 | 170.91 | 29.06 | 35. | 42. | 166. | .96 | .99 | .070 | 5.972 | 121. | 12.83 | .15 | -26. | 31. |
| .04492 | 137.90 | 43.40 | 43. | 19. | 156. | .97 | .89 | .294 | 2.041 | 127. | 18.93 | 4.59 | -25. | -41. |
| .05273 | 134.29 | 28.05 | 37. | 16. | 171. | .91 | .96 | .230 | 3.557 | 124. | 12.33 | 8.62 | -34. | 108. |
| .06250 | 137.76 | 17.19 | 29. | 30. | 168. | .87 | .89 | .135 | 9.108 | 134. | 18.28 | .89 | -37. | 117. |
| .07422 | 75.15 | 43.24 | 27. | 29. | 159. | .80 | .66 | .468 | 1.087 | 135. | 17.22 | 11.55 | -44. | 134. |
| .08984 | 120.05 | 38.21 | 18. | 35. | 156. | .87 | .85 | .443 | 1.347 | 130. | 30.83 | 12.34 | -38. | -44. |

DECOUPAGE EN 3

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .00537 | 96.46 | 54.70 | -147. | 46. | 122. | .20 | .46 | .415 | .694 | 38. | 34.11 | 26.09 | -20. | -16. |
| .00635 | 151.49 | 40.72 | 47. | 30. | 164. | .92 | .88 | .508 | 3.472 | 88. | 46.61 | 17.85 | -30. | -38. |
| .00781 | 257.89 | 13.06 | 55. | 86. | 177. | .98 | .62 | .064 | 4.761 | 195. | 31.59 | .78 | -18. | 46. |
| .00928 | 190.83 | 19.16 | 64. | 61. | 164. | .84 | .88 | .008 | 4.251 | 167. | 20.93 | .03 | -13. | 129. |
| .01123 | 157.23 | 16.04 | 58. | 64. | 175. | .45 | .81 | .094 | 3.358 | 96. | 11.46 | .66 | -19. | 78. |
| .01318 | 163.39 | 25.47 | 47. | 66. | 169. | .77 | .98 | .071 | 0 | 102. | 16.87 | .88 | -32. | 109. |
| .01562 | 193.95 | 28.63 | 46. | 57. | 169. | .93 | .97 | .269 | 0 | 134. | 13.93 | .54 | -27. | 76. |
| .01855 | 195.60 | 30.31 | 48. | 50. | 166. | .96 | .98 | .095 | 4.303 | 132. | 17.68 | .09 | -16. | 29. |
| .02246 | 201.08 | 27.33 | 43. | 48. | 166. | .93 | .97 | .079 | 5.177 | 131. | 17.56 | .40 | -20. | 36. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .05750 | 2185.05 | 832.21 | 76. | 87. | 51. | .38 | .77 | .992 | .669 | 116. | 1046.67 | 1515.95 | -37. | -36. |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .81250 | 402.87 | 357.55 | 50. | 109. | 215. | .66 | .75 | .905 | .092 | 118. | 275.26 | 300.70 | -36. | -38. |
| .93750 | 697.76 | 254.16 | 98. | 48. | 156. | .30 | .73 | 1.201 | .921 | 112. | 401.15 | 776.26 | -38. | 134. |
| 1.18750 | 341.92 | 149.73 | 96. | 52. | 136. | .44 | .32 | .768 | .330 | 118. | 101.57 | 152.19 | 134. | 130. |
| 1.43750 | 341.11 | 157.77 | 80. | 73. | 173. | .31 | .76 | .698 | 4.043 | 123. | 99.17 | 101.49 | -33. | -42. |
| 1.68750 | 445.83 | 240.05 | 83. | 19. | 81. | .55 | .33 | 1.116 | 1.770 | 118. | 58.52 | 134.04 | 130. | -28. |
| 2.00000 | 267.25 | 118.26 | 109. | 52. | 156. | .12 | .23 | .896 | 2.636 | 117. | 18.52 | 69.38 | -37. | 127. |
| 2.37500 | 613.55 | 2.71 | 102. | 119. | 173. | .12 | .31 | .676 | 6.813 | 122. | 79.79 | 103.75 | -19. | 123. |
| 2.87500 | 467.85 | 142.14 | 72. | 1. | 81. | .39 | .16 | .916 | 3.113 | 120. | 22.41 | 123.53 | 128. | -28. |
| 3.37500 | 330.71 | 73.19 | 72. | 68. | 174. | .18 | .29 | .559 | 3.314 | 120. | 73.82 | 79.27 | -36. | 126. |
| 4.00000 | 239.91 | 129.80 | 75. | 84. | 204. | .12 | .41 | .604 | .475 | 119. | 65.48 | 82.88 | -30. | -37. |
| 4.81250 | 307.25 | 120.66 | 87. | 96. | 185. | .29 | .65 | .499 | 1.417 | 123. | 85.47 | 64.02 | -23. | -32. |
| 5.75000 | 359.71 | 76.32 | 76. | 89. | 179. | .44 | .59 | .178 | 2.929 | 121. | 33.02 | 10.57 | -22. | 130. |
| 6.81250 | 283.18 | 118.34 | 79. | 74. | 173. | .73 | .75 | .239 | 8.759 | 123. | 10.89 | 13.21 | -32. | 122. |
| 8.06250 | 249.33 | 145.96 | 76. | 78. | 167. | .84 | .93 | .068 | 6.811 | 122. | 4.02 | 1.21 | -23. | 124. |
| 9.62500 | 276.74 | 161.72 | 79. | 76. | 172. | .85 | .64 | .050 | 3.981 | 121. | 2.67 | .13 | -13. | 130. |
| 11.5000 | 339.31 | 213.76 | 88. | 93. | 172. | .42 | .50 | .136 | .887 | 122. | 12.48 | 20.45 | -29. | 134. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 1359.12 | 226.82 | 61. | 108. | 67. | .13 | .36 | .767 | 2.100 | 125. | 403.31 | 429.62 | 94. | 115. |
| .35937 | 894.05 | 586.43 | 107. | 4. | 96. | .26 | .20 | .787 | 1.079 | 128. | 292.24 | 76.73 | 133. | 2. |
| .42187 | 645.22 | 155.01 | 59. | 39. | 61. | .15 | .16 | 1.301 | 1.139 | 124. | 338.28 | 217.32 | 90. | 108. |
| .50000 | 566.17 | 203.37 | 69. | 15. | 212. | .28 | .23 | .969 | .254 | 120. | 189.73 | 337.78 | 104. | 111. |
| .59375 | 1517.38 | 411.21 | 102. | 44. | 192. | .18 | .65 | .294 | 1.399 | 129. | 245.70 | 39.35 | -26. | 89. |
| .71875 | 911.46 | 103.80 | 85. | 62. | 64. | .06 | .28 | .576 | 1.245 | 125. | 388.82 | 5.35 | 122. | -32. |

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 349.47 | 245.66 | 76. | 78. | 159. | .81 | .99 | .159 | 2.210 | 77. | 13.28 | 8.42 | -32. | -41. |
| 14.0000 | 375.94 | 278.67 | 78. | 73. | 160. | .98 | .99 | .080 | 2.417 | 91. | 4.54 | 2.03 | -12. | -34. |
| 17.0000 | 536.10 | 384.75 | 93. | 59. | 159. | .86 | .99 | .414 | 3.880 | 100. | 17.65 | 49.52 | -20. | -42. |
| 20.0000 | 512.94 | 329.46 | 77. | 73. | 166. | 1.00 | .99 | .108 | 3.093 | 77. | 14.92 | 6.78 | -16. | -35. |
| 24.0000 | 506.90 | 483.48 | 82. | 69. | 184. | .98 | .96 | .208 | 5.754 | 64. | 9.47 | 36.72 | -19. | -42. |
| 29.0000 | 572.19 | 388.33 | 78. | 72. | 171. | .83 | 1.00 | .135 | 6.228 | 78. | 12.69 | 6.70 | -20. | -39. |
| 35.0000 | 612.67 | 550.77 | 79. | 72. | 158. | .99 | 1.00 | .090 | 2.265 | 74. | 2.89 | 4.37 | -18. | -38. |
| 41.0000 | 672.89 | 590.34 | 83. | 71. | 138. | .65 | .98 | .161 | 1.180 | 97. | 5.76 | 6.01 | -15. | -22. |
| 49.0000 | 817.50 | 194.14 | 79. | 46. | 137. | .92 | .75 | .451 | .367 | 137. | 148.11 | 79.05 | -2. | -5. |
| 58.0000 | 959.57 | 18.30 | 77. | 12. | 139. | .68 | .89 | .577 | .486 | 141. | 253.72 | 90.79 | -5. | -8. |
| 70.0000 | 1248.24 | 16.92 | 77. | 3. | 141. | .95 | .69 | .601 | .561 | 139. | 378.34 | 118.22 | -1. | . |
| 83.0000 | 1121.87 | 762.41 | 76. | 69. | 148. | .95 | .90 | .087 | 1.132 | 107. | 16.46 | 5.48 | -9. | -24. |
| 98.0000 | 1194.46 | 804.61 | 77. | 70. | 141. | .96 | .88 | .107 | .691 | 94. | 18.01 | 9.26 | -13. | -23. |
| 117.000 | 1383.01 | 1108.25 | 77. | 68. | 93. | .85 | .82 | .062 | 1.164 | 198. | 16.51 | 1.40 | 120. | -28. |

*** STATION A17 ***

DOMAINE HF

DECOUPAGE EN 59

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.0000 | 339.65 | 226.19 | 73. | 73. | 349. | .93 | .76 | .446 | .685 | 192. | 40.43 | 68.23 | 107. | 109. |
| 14.0000 | 283.68 | 219.41 | 75. | 78. | 184. | .91 | .79 | .239 | 1.557 | 196. | 8.06 | 25.94 | 97. | 114. |
| 17.0000 | 410.13 | 228.59 | 71. | 73. | 330. | .93 | .76 | .281 | 1.210 | 191. | 13.69 | 38.48 | 121. | 112. |
| 20.0000 | 532.01 | 418.91 | 101. | 96. | 305. | .98 | .54 | .790 | 4.613 | 201. | 11.80 | 161.51 | 103. | 114. |
| 24.0000 | 365.44 | 304.75 | 79. | 64. | 306. | .03 | .62 | .290 | 1.570 | 195. | 9.16 | 34.47 | 115. | 117. |
| 29.0000 | 619.24 | 23.55 | 65. | -35. | 305. | .32 | .05 | .757 | 1.602 | 342. | 38.99 | 173.64 | -36. | 105. |
| 35.0000 | 528.90 | 280.22 | 74. | 67. | 317. | .92 | .49 | .302 | 2.008 | 200. | 9.98 | 51.29 | 111. | 106. |
| 41.0000 | 1787.04 | 416.52 | 55. | 75. | 337. | .90 | .74 | .171 | .979 | 164. | 80.89 | 47.29 | -40. | 108. |
| 49.0000 | 954.06 | 119.31 | 64. | 1. | 294. | .57 | .70 | .591 | .823 | 162. | 245.36 | 282.07 | -36. | 124. |
| 58.0000 | 1595.58 | 235.43 | 57. | -30. | 295. | .26 | .69 | .503 | 1.502 | 181. | 720.58 | 129.72 | -14. | -27. |
| 70.0000 | 896.04 | 107.93 | 65. | -. | 285. | .64 | .60 | .474 | .532 | 184. | 113.74 | 145.60 | -42. | 120. |
| 83.0000 | 1099.12 | 647.95 | 61. | 57. | 322. | .73 | .56 | .250 | .894 | 184. | 40.03 | 153.67 | -42. | 120. |
| 98.0000 | 2133.23 | 594.58 | 52. | 78. | 333. | .93 | .74 | .059 | 1.291 | 183. | 113.02 | 19.21 | -30. | 117. |
| 117.000 | 5564.61 | 562.50 | 53. | 70. | 332. | .90 | .94 | .141 | 1.240 | 184. | 388.83 | 18.43 | -11. | -30. |

DOMAINE BF

DECOUPAGE EN 64

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .17187 | 161.42 | 125.13 | -161. | 12. | 291. | .24 | .29 | 3.247 | 1.050 | 268. | 24.23 | 150.10 | 125. | 127. |
| .20312 | 119.22 | 116.15 | 29. | 20. | 198. | .15 | .25 | 1.655 | .648 | 267. | 15.54 | 55.00 | 114. | -45. |
| .25000 | 966.39 | 839.71 | -176. | 31. | 237. | .62 | .48 | 1.704 | .585 | 267. | 295.16 | 938.77 | 130. | 131. |
| .29687 | 470.92 | 360.75 | -140. | 15. | 289. | .04 | .16 | 4.570 | .752 | 268. | 28.39 | 318.69 | -39. | -40. |

DECOUPAGE EN 16

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .04297 | 48.92 | 18.47 | 30. | 41. | 236. | .97 | .99 | .047 | 2.596 | 276. | 2.26 | .08 | 56. | 78. |
| .05078 | 41.35 | 18.32 | 35. | 39. | 243. | .97 | .95 | .171 | 1.416 | 275. | 2.08 | .89 | 78. | 96. |
| .06250 | 47.09 | 18.91 | 32. | 42. | 243. | .95 | .95 | .069 | 1.476 | 274. | 1.52 | .01 | 58. | 60. |
| .07422 | 36.63 | 14.14 | 39. | 17. | 233. | .75 | .88 | .042 | 3.509 | 276. | 1.57 | .17 | 82. | 125. |
| .08984 | 172.42 | 1.39 | 42. | 101. | 238. | .90 | .42 | .595 | 1.954 | 266. | 1.77 | 43.43 | 133. | -27. |
| .10547 | 64.58 | 23.55 | 34. | 121. | 224. | .15 | .11 | 1.334 | 1.924 | 271. | 5.79 | 24.89 | 118. | -40. |
| .12500 | 204.10 | 84.58 | -177. | . | 209. | .03 | .22 | 2.146 | .695 | 270. | 33.09 | 136.37 | -34. | 134. |
| .14844 | 313.96 | 290.07 | 32. | -312. | 165. | .09 | .17 | 4.121 | .512 | 269. | 153.00 | 511.99 | -33. | 127. |
| .17969 | 1886.68 | 1515.46 | 14. | -305. | 212. | .08 | .16 | 18.168 | 2.006 | 270. | 86.75 | 2146.12 | -40. | -36. |

DECOUPAGE EN 4

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .01074 | 417.70 | 39.40 | 91. | 8. | 200. | .12 | .87 | .992 | .435 | 268. | 56.91 | 48.78 | 135. | -31. |
| .01270 | 56.67 | 37.70 | -169. | 40. | 292. | .62 | .39 | .820 | .920 | 270. | 3.12 | 11.31 | 76. | 121. |
| .01562 | 72.52 | 9.29 | 54. | 19. | 316. | .75 | .98 | .532 | 2.832 | 272. | 2.43 | 5.61 | 135. | 85. |
| .01955 | 46.22 | 36.96 | 59. | 65. | 213. | .73 | .90 | .292 | 1.364 | 273. | 4.53 | 4.68 | 75. | 92. |
| .02246 | 75.23 | 19.21 | 50. | 44. | 244. | 1.00 | .97 | .098 | 1.273 | 285. | 2.19 | .57 | 61. | 14. |
| .02637 | 62.06 | 23.99 | 41. | 41. | 243. | .99 | .67 | .077 | 1.330 | 296. | 2.88 | .26 | 66. | 59. |
| .03125 | 63.63 | 26.55 | 39. | 46. | 238. | .99 | .95 | .116 | 1.953 | 272. | 2.74 | .13 | 66. | 71. |
| .03711 | 49.85 | 26.41 | 34. | 42. | 243. | .99 | .98 | .122 | 1.599 | 284. | 2.19 | .46 | 60. | 66. |
| .04492 | 46.32 | 19.73 | 37. | 38. | 240. | .97 | .99 | .086 | 1.708 | 280. | 2.21 | .32 | 54. | 36. |

DOMAINE MF

DECOUPAGE EN 24

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .66750 | 50.65 | 48.49 | 115. | 54. | 301. | .73 | .41 | .824 | 1.390 | 252. | 4.24 | 29.70 | 126. | 130. |
| .81250 | 203.33 | 33.81 | 36. | 71. | 190. | .92 | .71 | .624 | .325 | 255. | 26.55 | 29.77 | 124. | 133. |
| .93750 | 60.94 | 34.75 | 26. | 91. | 212. | .30 | .32 | 1.002 | 1.503 | 258. | 7.46 | 28.73 | 120. | 126. |
| 1.18750 | 89.51 | 23.35 | 64. | 81. | 219. | .81 | .33 | .662 | 4.123 | 264. | 10.16 | 16.39 | 122. | 133. |
| 1.43750 | 53.83 | 36.61 | 62. | 93. | 214. | .55 | .36 | .605 | 3.196 | 254. | 3.55 | 26.19 | 117. | 125. |
| 1.66750 | 86.15 | 34.56 | 70. | 74. | 344. | .73 | .67 | .343 | .635 | 257. | 3.81 | 7.12 | 106. | 99. |
| 2.00500 | 67.54 | 36.23 | 75. | 72. | 354. | .64 | .61 | .435 | 1.591 | 259. | 2.12 | 22.79 | 108. | 121. |
| 2.37500 | 77.75 | 42.79 | 80. | 76. | 312. | .85 | .56 | .326 | 1.183 | 257. | 1.94 | 4.83 | 105. | 87. |
| 2.87500 | 102.29 | 34.10 | 75. | 64. | 313. | .90 | .35 | .426 | 0 | 291. | 1.43 | 11.26 | 100. | 93. |
| 3.37500 | 94.35 | 68.25 | 80. | 76. | 342. | .66 | .69 | .259 | .734 | 250. | 3.34 | 5.56 | 98. | 100. |
| 4.00000 | 103.51 | 73.98 | 69. | 83. | 220. | .78 | .36 | .295 | 2.038 | 264. | 3.88 | 5.22 | 111. | 124. |
| 4.81250 | 103.68 | 87.28 | 78. | 78. | 331. | .97 | .83 | .154 | 1.515 | 276. | 1.10 | 2.28 | 89. | 88. |
| 5.75000 | 114.50 | 69.79 | 81. | 77. | 305. | .96 | .80 | .166 | 3.132 | 271. | .93 | 2.58 | 98. | 97. |
| 6.81250 | 141.81 | 132.14 | 79. | 77. | 343. | .98 | .85 | .132 | 2.244 | 267. | 1.63 | 2.95 | 94. | 104. |
| 8.06250 | 156.90 | 137.35 | 79. | 78. | 352. | .98 | .97 | .113 | .327 | 270. | 1.56 | 1.89 | 84. | 86. |
| 9.62500 | 162.70 | 156.55 | 79. | 79. | 356. | .97 | .96 | .108 | .131 | 276. | 1.82 | 1.95 | 86. | 85. |
| 11.5000 | 275.41 | 167.08 | 79. | 72. | 320. | .90 | .88 | .205 | 6.644 | 255. | 2.06 | 10.02 | 91. | 96. |

DECOUPAGE EN 6

| FREQ | RMAX | RMIN | PHMAX | PHMIN | ROTANG | COHX | COHY | SKEW | ELLI | TIPANG | R1 | R2 | PH1 | PH2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .29687 | 64.29 | 59.87 | 61. | 105. | 203. | .36 | .28 | .954 | 1.176 | 260. | 35.49 | 62.10 | -20. | -28. |
| .35937 | 78.02 | 48.12 | 130. | 36. | 305. | .21 | .66 | 1.251 | 1.449 | 275. | 3.03 | 65.19 | 131. | 133. |
| .42187 | 103.18 | 35.33 | 92. | -294. | 316. | .33 | .03 | 1.410 | 1.819 | 268. | 1.40 | 49.76 | 117. | 98. |
| .50000 | 39.52 | 7.09 | 27. | 79. | 220. | .26 | .35 | .973 | 3.989 | 274. | 4.50 | 14.09 | 106. | 124. |
| .59375 | 61.51 | 8.64 | 63. | 54. | 223. | .50 | .39 | .204 | 3.027 | 267. | 4.28 | 3.08 | 92. | 132. |
| .71875 | 235.72 | 60.31 | 33. | 8. | 232. | .33 | .44 | 1.423 | 3.541 | 269. | 2.43 | 83.92 | 97. | -40. |

# MAGNETOTELLURICS

# MAGNETOTELLURICS

## 1 - DEFINITION

It is a resistivity method which uses as source the time-dependent variations of the earth's magnetic field and the associated induced currents in the conductive earth.

The periods of these fluctuations range from milliseconds to several years. However the variations with periods smaller than 1 msec do not penetrate very deep into the earth and, therefore, are of little use in depth sounding. Conversely periods longer than one day are not used in oil exploration as their depth of investigation exceeds the normal range of interest.

A plot of the amplitude versus frequency for magnetic variations shows a minimum for frequency 1 Hz.

Frequencies higher than 1 Hz are created by lightning strokes resulting from thunderstorm activity mainly concentrated in the tropics. There are three storm centers located in Brazil, Central Africa and Malaysia which have an average of 100 storm days/year.

Frequencies lower than 1 Hz result from the displacement of ionized particles in the upper atmosphere, triggered by solar activity or by the relative motion of the earth, sun and moon. Depending on their frequency and pattern these micropulsations have been classified in regular Pc pulsations (0.2 to 600 sec), irregular pulsations (1 to 150 sec) and pearls pulsations (0.3 - 3 sec). The latter are related to auroral displays.

./..

Normally, the magnetic and the electric signals are highly correlated and it will be possible to compute the variations of an "apparent resistivity" as a function of the period of the measured signals. (This procedure will be explained in the part dealing with the processing of MT data). As the penetration of electromagnetic waves in a medium depends upon the resistivity of this medium and upon the period of the signal (skin effect phenomenon), one easily realizes that the depth of penetration of this method increases with the period. Therefore the plot of the apparent resistivity versus the period represents, in fact, an investigation with depth of the true resistivities.

## 2 - FIELD LAY - OUT - EQUIPMENT - COMPOSITION OF THE CREW

In conventionnal MT, one uses a classical five component array (see fig. 1). One simultaneously records the variations

- of the electrical field in two horizontal directions at right angles (Ex, Ey). In fact, one measures the potential difference which exists between the two electrodes of a dipole.

- of the magnetic field in three directions at right angles, two of them Hx, Hy being parallel to the electrical dipoles (Hx // Ex and Hy // Ey), the third one being vertical.

### 2.1 - Potential dipoles

Their length is usually in the order of 200 m, the longer, the better. However practical considerations limit their length which seldom exceeds 300 m (presence of roads, topographic effects, presence of possible noise source in their vicinity such as electrified fences, burried pipes ...). Electrodes are of the impolarisable type, filled with a cadmium chloride.

In order to eliminate any noise generated by the movement of the dipole cable by the wind, pods of earth are sometimes placed every 1 m apart on the cable (a conductive cable moved in the earth's magnetic field induces a current).

The equipment measures the difference of potential existing between two electrodes (in mV).

### 2.2 - Magnetometers (model CM 10 or CM 11) - see fig. 2 - They are used to measure the variations of the earth magnetic field in three directions.

They are of the induction type. They comprise 600,000 turns of copper wire wounded around a core of high magnetic permeability (mumetal). They have a very flat response over a broad frequency range due to a special feed back system and are equipped with a preamplifier. The magnetometer is a cylinder 1.8 m long and 15 - 20 cm wide for the CM 10 and 1 m long for the CM 11

The horizontal magnetometers are carefully orientated and levelled within a fraction of a degree. They are burried in tranchees 30 to 50 cm deep.

The vertical magnetometer is placed vertically in an auger hole and levelled with the same care as the horizontal magnetometers.

All these precautions are taken to eliminate any source of noise arising from thermal variations and vibrations (wind for instance).

Comparison between cryogenic and induction magnetometers.

The CM 10 or CM 11 induction magnetometers have a negligible electronic noise in the 10 - 100 Hz range, the noise is only due to the thermic noise of the coil itself. This is a frequency range where the signal is frequently weak. For periods above 20 seconds, the noise is much lower for cryogenic magnetometers than for induction ones but it is also above 20 seconds that the natural signal is usually strong enough for the instrumental noise to be negligible.

Field operations are also much easier with induction magnetometers : handling liquid helium is not always simple, supply is costly and sometimes irregular, difficulties in filling up due to ice formation in the magnetometer Dewar collar may arise. The electronics of induction magnetometers are simple and easily repaired in case of breakdown. Of course it is out of question to use a CM 10 magnetometer as a vertical component detector because of its size (1,80 long) but a CM 11 one (1m) is quite convenient.

To conclude, one to one comparisons with a SHE cryogenic magnetometer carried out by CGG speaks in favor of the CM 10, at least for horizontal components and periods of practical interest for oil exploration.

2.3 - MT recording equipment (see fig 3)

The equipment which is presently used in Japan is named M3T. It is composed of three units installed in an air - conditionned cabin mounted on a light truck. If necessary, the equipment can be disassembled and carried by hand in separate smaller units weighting 15 to 40 Kg. It is then removed in a tent. No air-conditionning is required providing the temperature does not exceed 24° C.

The various functions performed by this equipment are :

- Processing of analog signals. There are six identical channels. Each of them perform the following functions

. preamplification (differential) - impedance : $10^{10}$ ohms - noise : 1,5 $\mu$V peak to peak from 0.01 to 1 Hz at gain 100 - drift : $\pm$ 2 $\mu$V/°C - gains : 5, 10, 20, 50, 100, 200

. high pass filters : 0.005 Hz ← 3 dB ; 6 dB/octave
0.2 Hz ← 3 dB ; 12dB/octave

. low pass filters : 100 Hz ← 3 dB ; 24dB/octave

. notch filters : 50 Hz and 150 Hz or 60 Hz and 180 Hz

. SP bucking

. antialiasing filters : 1 Hz ← 3 dB ; 36dB/octave
16 Hz ← 3 dB ; 36dB/octave
128 Hz ← 3 dB ; 36dB/octave

. amplification gains : 1 - 3 - 10 - 30 - 100 - 300

. selecting the frequency range (HF = 0,2 to 128 Hz, MF = 0,2 to 16 Hz, LF = 0 to 1 Hz or 0.005 to 1 Hz). However low and high cut filters may be combined in any manner and remain independent for each channel

- graphic display of recorded traces The plotter has six traces (type MFE 1600). Each channel comprises.

. preamplifier with 9 sensitivities from 10 V/cm to 20 mV/cm

. 50 mm wide track

- Digitization, automatic gain, control unit, multiplexing. Digitization and amplification are carried out by a single unit for all six channels.

. voltages are converted on 12 bits (11 bits + sign)

. sampling rate : 4 - 64 - 512 Hz

. conversion time : 25 $\mu$s

. dynamic range : $\pm$ 10 volts

. automatic gain : 1 - 2 - 4 - 8

These operations are carried out with a 16 bit microprocessor with 10 kwords of RAM and 16 kwords of EPROM*.

Interfacing with the tape recorder is done by a board with 2 kwords of RAM**.

- Magnetic tape recorder : the recorder (type Kennedy 9800) works in the stop-start mode

. 9 tracks - 800 bpi - NRZI norm

. 1/2 inch - 1200 feet

. recording speed : 25 ips - odd parity.

One field tape contains several stations. Each record is made of several blocks, each block has 3010 bytes. The first block is a header which contains the necessary information for the processing : name of the station, domain, length of the telluric lines, type of magnetometers ... The next blocks are the signal blocks. Samples are multiplexed. Each sample needs two bytes (12 bits for the converted value and 4 bits for the binary gain used during the recording)

- Dialogue. It is carried out with a keyboard - printer (type Texas Instrument Silent SR 743) - (asynchronous liaison - 300 bands - type RS 232 C).

- Power supply : 220 V (50 or 60 Hz) generator - 1 KWA.

* EPROM = Erasable Programmable Read Only Memory.

** RAM = Random Access Memory.

## 2.4 - Composition of the crew

A typical MT crew will include :

. a geophysicist

. 1 operator

. 1 surveyor responsible of the field lay out

. 3 to 4 labourers. In mountainous areas where the equipment has to be carried out, it is sometimes necessary to add some extra labourers.

. one M3T recording unit.

. 2 CM 10 induction magnetometers to measure the horizontal components of the magnetic field + 1 CM 11 (smaller size) or CM 10 to measure the vertical component.

. non-polarisable electrodes + connecting cables.

. 3 vehicles including the cabin truck housing the M3T recording unit.

## 2.5 - Field lay-out - Quality control in the field

The two potential dipoles are laid out in a L shape array or in a cross whose center coïncides with the dipoles middle points. Furthermore, one must try as much as possible, to lay-out the two dipoles horizontally

Topographic relief in excess of 10 % can strongly affect the measurements as they act as resistivity heterogeneities. Presently CGG does not correct the measurements from this effect.

Each magnetometer is located several meters away from adjacent ones to avoid interferences. Great care must be given to their stability to avoid vibrations which generate a noise.

The surveyor of the crew is responsible for the choice of the site, for the access to the area and for the positionning of the dipoles and magnetometers.

The recording of a MT sounding is done in three parts :

- recording of HF ( 2 to 5 mn)
- recording of MF (15 to 20 mn)
- recording of LF ( 1 to 5 hours)

The duration of a complete sounding will range from 2 hours to 5 hours depending upon the frequency range, the noise, the accessability to the site ... A minimum length of recording for each frequency band will be 10 times the longest period of the band. Daily output : 1 to 2 stations.

The quality control in the field is done in two ways (see fig 4)

- the permanent analog display of the five traces allows a constant check of what is recorded during the measurements. The operator can indicate on the analog record any abnormal event which can explain bursts on the record ... These pieces of information will be used at the processing stage to select good portions of records.

- band-pass filtering can be applied in the field allowing the operator to check the coherency existing between the magnetic and the electric fields in a given frequency window.

## 3 - PROCESSING OF MT DATA

Our processing is done by harmonic analysis and involves several steps :

### 3.1 - Assessing the quality of the records

This is done by examining the analog record obtained from the field with the operator's indications. From this examination it is possible to infere the existence of noise, wind... and, if necessary the record will be downgraded in which case, it will not be interpreted or only part of it will be used.

### 3.2 - Demultiplexing the field tape

On the field tape, data are organized in sequential order. For a given time, on obtains the five component values in a row ; then the time, is incremented by one sampling interval and five new values are recorded.

This operation is repeated for each frequency band. This tape is demultiplexed and 15 sequential files are created, one for each component 5 files and repeated for each frequency band yielding 5 x 3 = 15 files.

At the same time, some editing of the data is performed, mainly spike removal and replacing of missing values by interpolation.

### 3.3 - Computing the spectral power distribution for each file

This is done by taking a number of samples equal to a power of 2 (from 256 to 8192), removing their average value and tapping the sample collection at both ends. Then a FFT algorithm is applied which yields from 256 to 4096 complex spectral values corresponding to different frequencies. Each spectral value is defined by an in-phase and an out-of-phase component.

The next stage will be to correct the computed values for the frequency response of the sensor (amplitude and phase) as well as for the

gain used during recording.

Finally, one obtains the following table

| | | Ex comp | | Ey comp | | Hx comp | | Hy comp | | Hz comp | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| High frequency 0.2 to 128 Hz | 1 | $Ex_1^1$ | $Ex_1^{1*}$ | $Ey_1^1$ | $Ey_1^{1*}$ | $Hx_1^1$ | $Hx_1^{1*}$ | $Hy_1^1$ | $Hy_1^{1*}$ | $Hz_1^1$ | $Hz_1^{1*}$ |
| | 4096 | $Ex^1$ 4096 | $Ex^{1*}$ 4096 | $Ey^1$ 4096 | $Ey^{1*}$ 4096 | $Hx^1$ 4096 | $Hx^{1*}$ 4096 | $Hy^1$ 4096 | $Hy^{1*}$ 4096 | $Hz^1$ 4096 | $Hz^{1*}$ 4096 |
| Medium frequency 0.2 to 16 Hz | 1 | $Ex_1^2$ | $Ex_1^{2*}$ | $Ey_1^2$ | $Ey_1^{2*}$ | $Hx_1^2$ | $Hx_1^{2*}$ | $Hy_1^2$ | $Hy_1^{2*}$ | $Hz_1^2$ | $Hz_1^{2*}$ |
| | 2048 | $Ex^2$ 4096 | $Ex^{2*}$ 4096 | $Ey^2$ 4096 | $Ey^{2*}$ 4096 | $Hx^2$ 4096 | $Hx^{2*}$ 4096 | $Hy^2$ 4096 | $Hy^{2*}$ 4096 | $Hz^2$ 4096 | $Hz^{2*}$ 4096 |
| Low frequency 0.005 to 1 Hz | 1 | $Ex_1^3$ | $Ex_1^{3*}$ | $Ey_1^3$ | $Ey_1^{3*}$ | $Hx_1^3$ | $Hx_1^{3*}$ | $Hy_1^3$ | $Hy_1^{3*}$ | $Hz_1^3$ | $Hz_1^{3*}$ |
| | 512 | $Ex^3$ 4096 | $Ex^{3*}$ 4096 | $Ey^3$ 4096 | $Ey^{3*}$ 4096 | $Hx^3$ 4096 | $Hx^{3*}$ 4096 | $Hy^3$ 4096 | $Hy^{3*}$ 4096 | $Hz^3$ 4096 | $Hz^{3*}$ 4096 |

3.4 - Computing of impedances

At a given frequency (w) there are generally the following relations between the five spectral components : Hx, Hy, Hz, Ex, Ey.

$$Ex\ (w) = Zxx(w)Hx(w) + Zxy(w)Hy(w)$$
$$Ey\ (w) = Zyx(w)Hx(w) + Zyy(w)Hy(w)$$
$$Hz\ (w) = Zzx(w)Hx(w) + Zzy(w)Hy(w)$$

One intends to compute the complex impedances Zxx, Zxy, Zyx, Zyy, Zzx and Zzy.

These calculations are usually performed for a finite number of frequency windows (usually 13 per decade of period). These frequency windows are distributed according to a geometrical progression (regular spacing of frequencies when plotted on a logarithmic scale).

Calculations are done according to the following procedure, for each frequency window.

- one computes the average autocorrelation function for each spectral component $HxHx^*$, $ExEx^*$, $HyHy^*$, $EyEy^*$, $HzHz^*$.

- one compute the average intercorrelation for each two of these components $ExHy^*$, $EyHx^*$.....

- the corresponding impedance will be computed using two algorithms which will tend to eliminate non-coherent signals :

- The first algorithm eliminates specific telluric noise and leads to an impedance value which can be underestimated due to possible specific magnetic noise.

For instance :

$$Zxy = \frac{\overline{(HxHy^*)}\,\overline{(ExHx^*)} - \overline{(HxHx^*)}\,\overline{(ExHy^*)}}{\overline{(HxHy^*)}\,\overline{(HyHx^*)} - \overline{(HxHx^*)}\,\overline{(HyHy^*)}}$$

$$Zyx = \frac{\overline{(HyHx^*)}\,\overline{(EyHy^*)} - \overline{(HyHy^*)}\,\overline{(EyHx^*)}}{\overline{(HyHx^*)}\,\overline{(HxHy^*)} - \overline{(HyHy^*)}\,\overline{(HxHx^*)}}$$

- A second algorithm allows to eliminate specific magnetic noise and leads to impedance values which can be overestimated due to specific telluric noise.

$$Zxy = \frac{\overline{(HxEx^*)}\,\overline{(ExEy^*)} - \overline{(HxEy^*)}\,\overline{(ExEx^*)}}{\overline{(HxEx^*)}\,\overline{(HyEy^*)} - \overline{(HxEy^*)}\,\overline{(HyEx^*)}}$$

$$Zxx = \frac{\overline{(HyEy^*)}\,\overline{(EyEx^*)} - \overline{(HyEx^*)}\,\overline{(EyEy^*)}}{\overline{(HyEy^*)}\,\overline{(HxEx^*)} - \overline{(HyEx^*)}\,\overline{(HxEy^*)}}$$

### 3.5 - Computing the invariant

Once the impedances are computed, one can calculates a quantity called the invariant which is independant from the orientation of the MT array relatively to the underlying structures. The invariant is equal to :

$$\left| Zxx\ Zyy - Zxy\ Zyx \right|$$

Rather than plotting the invariant versus the period, one prefers to compute an apparent resistivity.

$$\rho_{INV} = 0.2\ T \times \left| ZxxZyy - ZxyZyx \right|$$

Depending upon the algorithm used to compute the corresponding impedances, this quantity will be under or overestimated or correct.

### 3.6 - Coherency

Furthermore, one computes the coherency existing between the two components considered :

$$C^2(Ex,Hy) = \frac{\overline{(ExHy^*)} \times \overline{(HyEx^*)}}{\overline{(ExEx^*)} \times \overline{(HyHy^*)}}$$

This parameter reflects the measurement quality. Good quality data yield coherency comprised between 0.95 and 1.00.

3.7 - Determining the main trends of the structure (See fig. 5)

One rarely encounters perfectly tabular structures made of horizontal layers extending indefinitly in all horizontal directions. In fact structures are, most of the time two or three dimensional. Therefore the results of MT processing will depend upon the orientation of the field array relatively to the underlying structures.

In order to overcome this problem, one will determine the main structural directions then rotate the impedance tensor according to these new directions OX, OY and compute the apparent resistivities along these main trends.

To do so, one rotates the Fourier transforms 10° at a time and calculates rotated impedances knowing the values of Zij as a function of $\theta$, it is possible to convert Zij into apparent resistivity values

$$\rho_a = 0.2\ T \left| Zij \right|^2$$

These apparent resistivity values are plotted on a polar graph (See fig. 6) which readily displays the main trend axes. Its shape is indicative of the type of structure underlying the station.

- circular for tabular structures
- ellipse for 2D structures
- undefined for 3D structures.

Note :

1) The main trends thus defined are a function of the frequency window used for the calculation.

2) The directions computed while only considering Zxx, Zxy, Zyy, Zyx are defined with a $\pi/2$ uncertainty. This uncertainty is resolved by the use of the vertical magnetic component. A polar diagram of Zzx is plotted :

$$Hz = ZzxHx + ZzyHy$$

In the case of a two dimensional structure parallel to y, Zzy = 0, Hz = ZzxHx. Thus the maximum of $|Zzx|^2$ gives the orientation corresponding to an electrical axis perpendicular to the structure.

Instead of determining the main trends from polar diagrams of each impedance, one can also study the variations of the quantity

$$\frac{Z'xx^2 + Z'yy^2}{Z'xy^2 + Z'yx^2} \quad \text{versus } \theta$$

the minimum and maximum of this function give the answer.

These operations should be done for each period window. In fact, at C.G.G., one only determines an average rotation angle computed over a large period window (low frequency range for instance). This angle will be applied for all the periods of the station.

### 3.8 - Computing the resistivity diagrams in the main directions

Once the main directions have been determined, one can compute the apparent resistivity curves along these directions (See fig. 7). There are two options at C.G.G.

Option 1

$$\rho_{a\,xy} = 0.2\ T\ |Zxy|^2$$

$$\rho_{a\,yx} = 0.2\ T\ |Zyx|^2$$

For each impedance, one can use three different algorithms.

Algorithm 1 correponds possibly to underestimated values due to specific magnetic noise. The result is not affected by non-coherent telluric noise.

Algorithm 2 corresponds to possibly overestimated values due to specific telluric noise. It is unaffected by specific non-coherent magnetic noise.

In option 2, the formula are

$$\rho_{a\,xy} = 0.2\ T\ \left|\frac{Ex}{Ey}\right|^2$$

$$\rho_{a\,yx} = 0.2\ T\ \left|\frac{Ey}{Ex}\right|^2$$

There are three possible algorithms.

Algorithm 1 : corresponds to eventually underestimated values

$$\rho_{a\,xy} = 0.2\ T\ \left|\frac{\overline{(ExHy^*)}}{\overline{(HyHy^*)}}\right|^2$$

elimination of non-coherent telluric noise

$$\rho_{a\,yx} = 0.2\ T\ \left|\frac{\overline{EyHx^*}}{\overline{HxHx^*}}\right|^2$$

(See fig. 8)

Algorithm 2 corresponds to eventually overestimated values

$$\rho_{a\,xy} = 0.2\ T \left| \frac{\overline{ExEx^*}}{\overline{ExHy^*}} \right|^2$$

elimination of non-coherent magnetic noise

$$\rho_{a\,yx} = 0.2\ T \left| \frac{\overline{EyEy^*}}{\overline{EyHx^*}} \right|^2$$

(See fig. 9)

Algorithm 3 is the geometric average of the two previous values (See fig. 10).

Fig. 8, 9 and 10 represent the same apparent resistivity diagram computed with algorithms 1, 2 and 3 - Option 2.

In this case, the best result is achieved with algorithm 2 which suggests that non-coherent noise mainly affect the magnetometer trace.

By trying the three algorithms on several MT soundings representative of the general conditions prevalent in the survey area, the geophysicist is able to select the algorithm which gives the best result. Then this algorithm is used for the whole survey.

Note that for each apparent resistivity value, all computed values are plotted in statistical form (Gaussian curve). This graphical display allows a quick estimate of the measurement quality (See fig. 11).

## 4 - INTERPRETATION OF MT DATA

The interpreter has the following data :

- polar graphs of apparent resistivities for one or several period windows
- 3 apparent resistivity curves ($\rho_a$ inv, $\rho_a$ // and $\rho_{a\perp}$)
- various indicators computed during processing for instance

$$\text{Skew} : S = \frac{|Zxx + Zyy|}{|Zxy - Zyx|}$$

$$\text{Tipper} : T = \sqrt{|Zzx|^2 + |Zzy|^2}$$

These two parameters which are the most frequently used supply information about the underlying structures :

| | tabular | 2D | 3D |
|---|---|---|---|
| Skew | 0 | 0 | $\neq 0$, the higher, the more away from a 2D structure |
| Tipper | 0 | $\neq 0$ | $\neq 0$ |

### 4.1 - Qualitative interpretation of MT data

The qualitative interpretation is based upon the examination of the following documents :

- apparent resistivity map for a given period T
- total conductance map
- apparent conductance map corresponding to a period T
- pseudo-sections displaying for each station of a profile, on a vertical line the apparent resistivity versus period or the apparent resistivity versus depth of penetration.

4.2 - Quantitative interpretation

Among the two rotated curves and the invariant apparent resistivity curve the interpreter selects one on the basis of two criteria :

- compatibility with an interpretation resulting in a series of horizontal layers,
- quality of the S/N.

The interpreter smoothes the plotted curves by hand controlling the smoothing with master curves in order to obtain a curve defined by a continuous line which will later be sampled. The smoothed curve is sampled (30 - 50 samples equally spaced on the logarithmic scale). Ordinates are given in millimeters and a weight may be given to any particular sample.

The next step is the application of an "automatic inversion" method. It is assumed that the curves can be interpreted as due to a series of horizontal layers. The procedure is presented in "Processing and Interpretation of Magnetotelluric Soundings" by G. Kunetz (Geophysics, v. 37, pp. 1005 - 1021, 1972) and "Essais d'Amélioration du Traitement et de l'Interprétation des Enregistrements Magnétotelluriques" by J.P. Rocroi and P. Andrieux, (Geophysical Prospecting, vol. 23, no. 4, 1975, pp. 749 - 764).

Without going through an explanation of the principle of the method it may be said that the inversion algorithm gives a solution corresponding to a large number (300 in the present case) of elementary layers, for all of them the ratio "thickness/square root of the resistivity" is equal to the ratio determined for the first upper layer (see fig. 12). The "first upper layer" may be taken as a subdivision of the actual upper layer. It goes with-out saying that it is not assumed that the result of the inversion represents a realistic geological series. It is not realistic, but, because it comprises a large number of elementary layers the corresponding theoretical curve coincides practically with the experimental curve, thus no information is lost.

Instead of using brute force in order to achieve a best fit between the experimental data and an acceptable interpretation, the interpreter simplifies the comprehensive solution within the limits allowed by the equivalence rules thus he is assured that the proposed interpretation remains compatible with the data and a single computer job will be enough to obtain a perfect fit between the experimental data and the interpretation (see fig. 13).

A powerful aid in the simplification work is the Dar Zarrouk curve. The Dar Zarrouk curve shows on a log-log scale the variations of the ratio "depth/cumulated conductances" * versus depth. It can be demonstrated that a MT Sounding is completly defined when the corresponding D.Z. curve is known.

Each layer is represented on the Dar Zarrouk curve by an arc which is part of only two elementary master curves. It is relatively easy to visually determine where the detailed contour corresponding to the comprehensive solution can be simplified by replacing composite main arcs by simple arcs taken on the two master curves. It is thus possible to determine quickly the minimum number of electrical markers which should be considered even when considering a large number of layers. Actually the D.Z. curve remains almost the same whatever the number of layers used for the comprehensive solution.

In summary, solutions acceptable for a given geological situation are established by taking simultaneously into account :

- The available geological information,
- The D.Z. curve,
- The phase difference curve,
- The principle of equivalence which states that within certain limits, a resistive marker influences the MTS curve through its thickness only, whereas a conductive one influence it through its conductance. Within certain limits the interpreter may alter the resistivity of a resistive marker, the thickness and resistivity of a conductive marker provided their thickness and conductance remain respectively constant.

* The conductance of a layer is the ratio thickness/resistivity

Where it appears that an interpretation in terms of horizontal layers is not acceptable and there are indications of a two dimensional structure the interpreter uses computer generated two dimensional models.

Customers receive data in the following form :

A. Written report discussing technique and processing procedure.

B. One reproducible map showing station locations and electrical set-up.

C. One reproducible copy of each recorded Apparent Resistivity and Phase Difference curve (two per station). A graph plotted above each Apparent Resistivity curve shows the variations with frequency of the coherence between the recorded magnetic and electrical components. One cycle of the bilogarithmic grid corresponds to 62.5 mn.

D. One copy of the hodograms showing the determination of the electrical strike with calculation of the tipper.

E. One reproducible copy of the Apparent Resistivity curves (two per station) obtained by calculated rotation of the recorded data wherever one of the axes of the recording array does not coincide with the electrical set-up.

F. If justified, one copy of the Apparent Resistivity pseudo-sections corresponding to the lines (on pseudo-sections, pseudo-depths are proportional to the apparent skin depths).

G. If justified, one reproducible copy of the Total Conductance profiles (Total Conductance at one station = sum of the ratios "thickness/ resistivity" for all layers of the sedimentary series).

H. One copy of the computer print-outs corresponding to the comprehensive solutions obtained by automatic inversion giving thicknesses, resistivities, depths and cumulated conductances.

I. If justified, one copy of the Dar Zarrouk curves forming pseudo-sections where correlations can be readily observed.

J. One reproducible copy of the final interpretative sections along the MT lines showing depths, thicknesses and resistivities of the electrical markers.

K. One copy of the interpretation report.

# Fig. 1 _ MAGNETOTELLURICS

## 5 · Components MT ARRAY

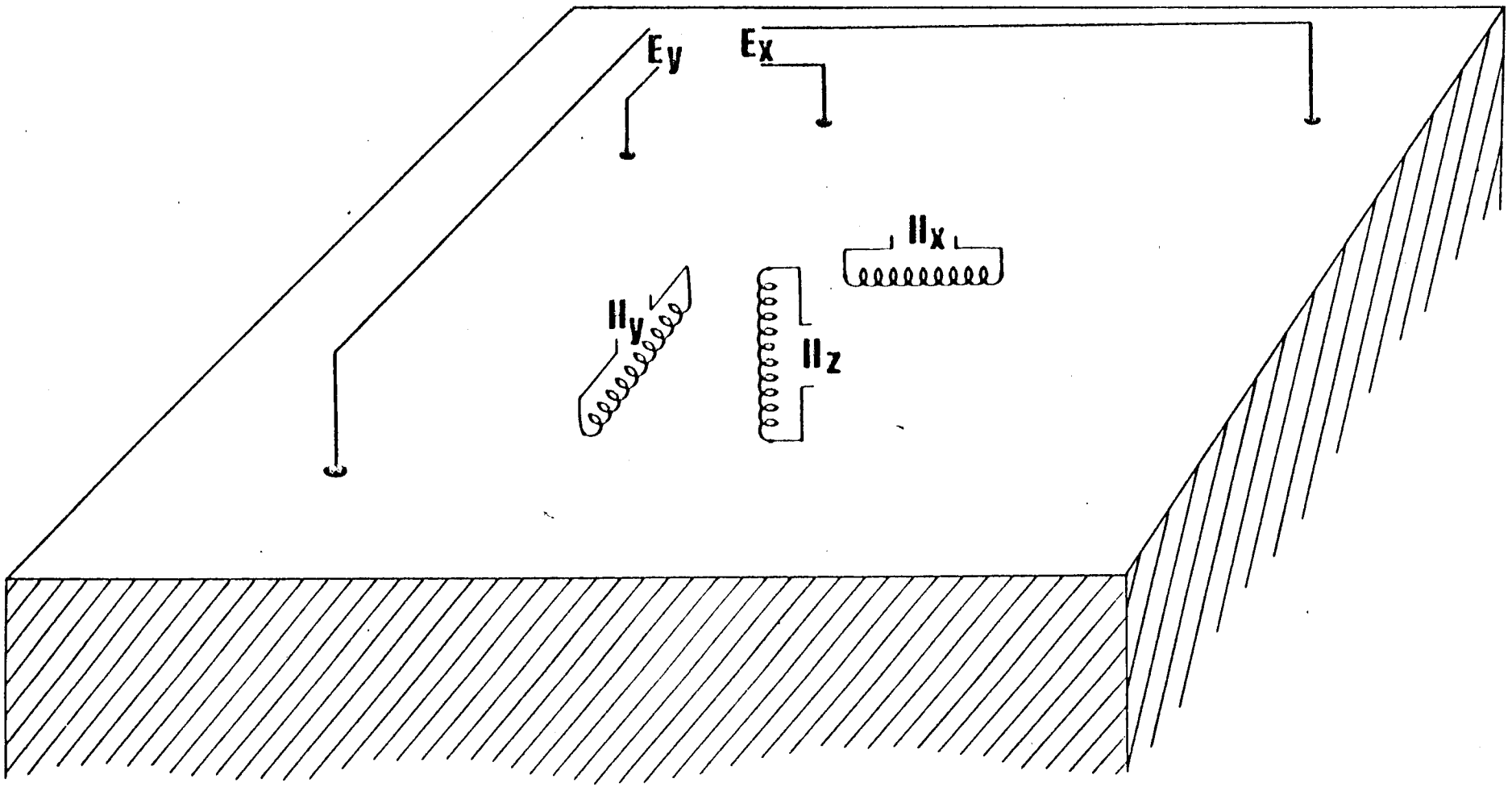
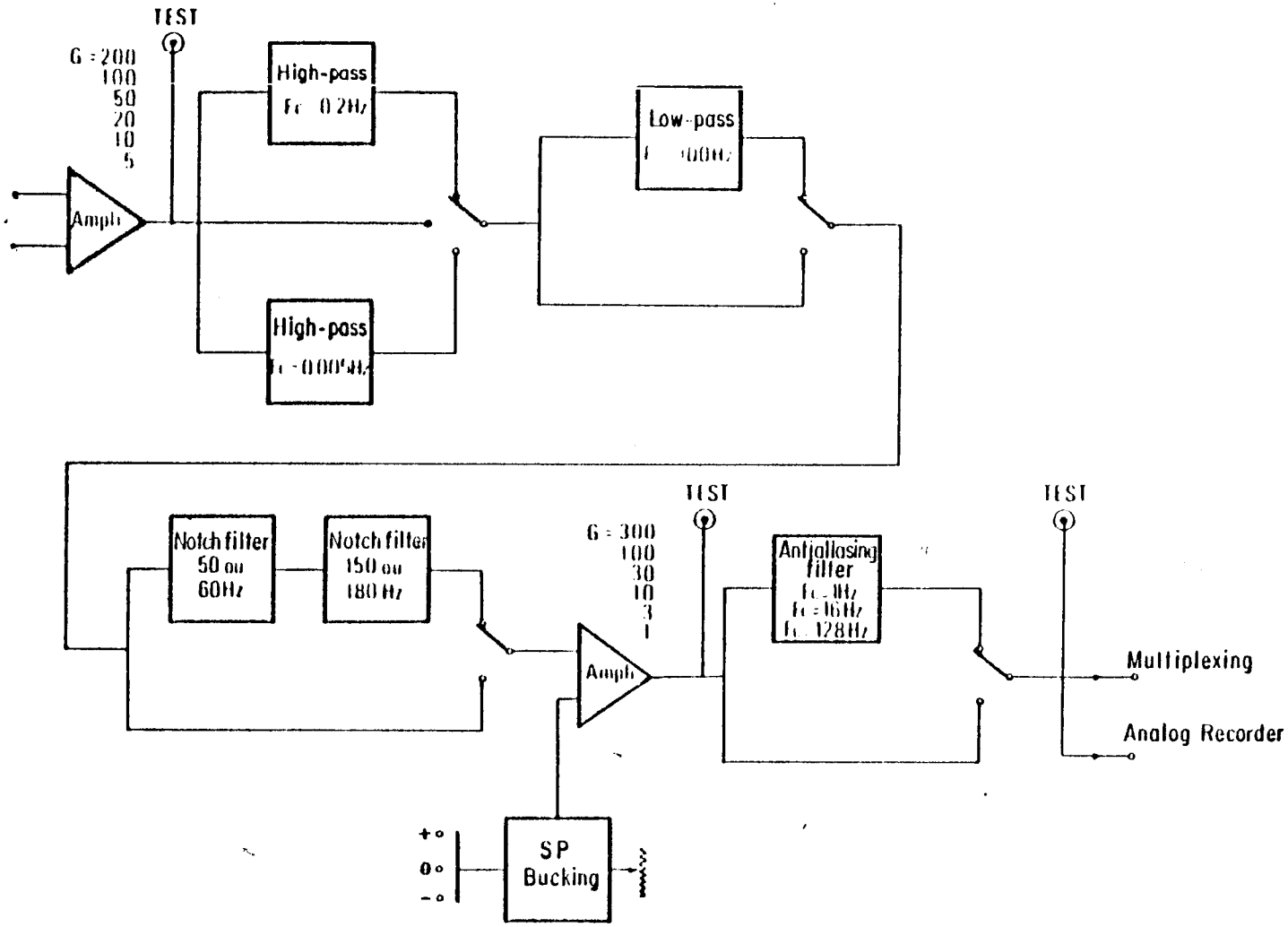


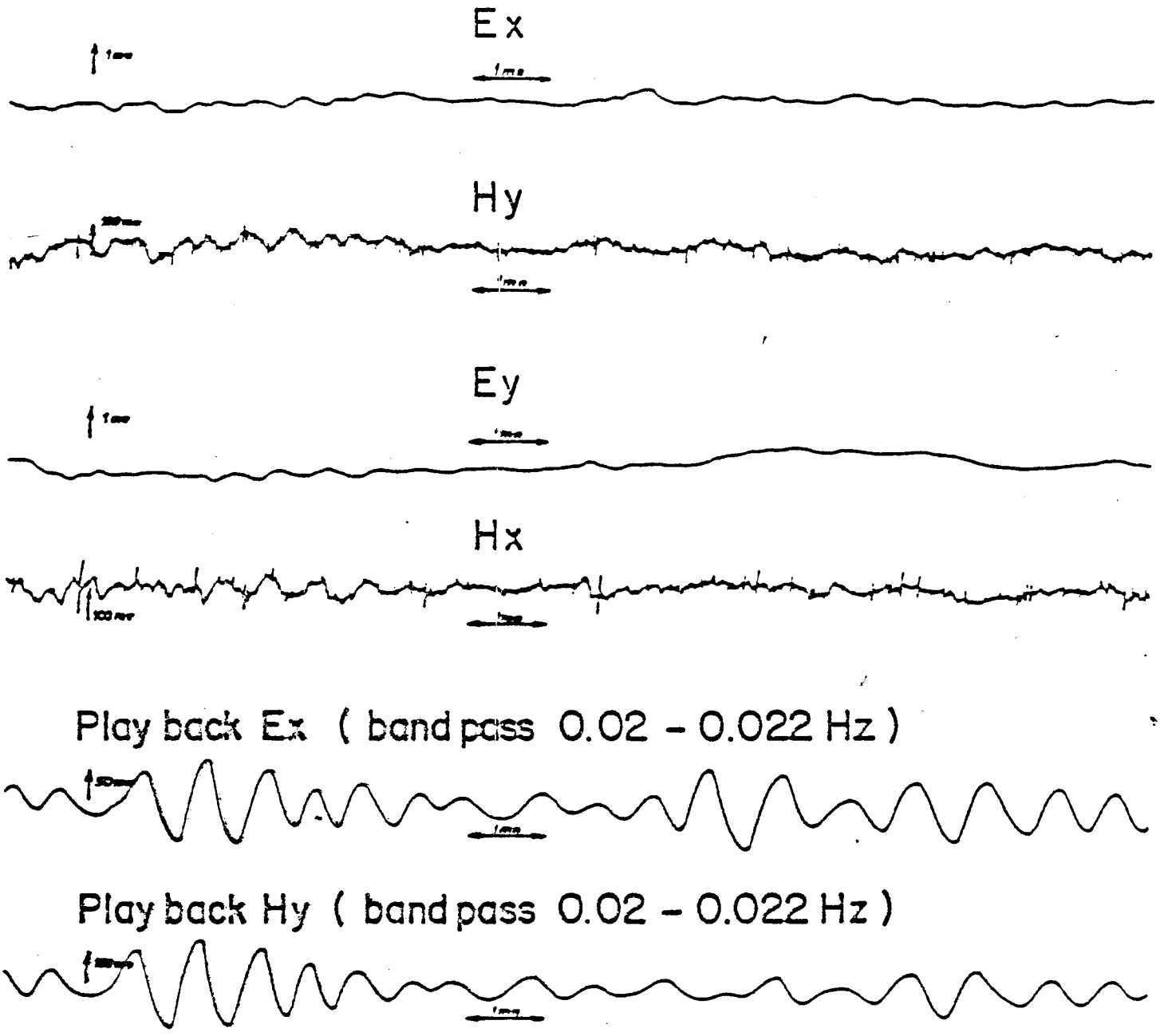
Fig. 2 - AMPLITUDE RESPONSE CURVES OF THE CM10 INDUCTION MAGNETOMETERS.




| Range | Band pass(Hz) | Gains |
|---|---|---|
| LF | 0 - 1 ou 0.005 - 1 | 5 a 60 000 |
| | | " |
| MF | 0.2 - 16 | " |
| HF | 0.2 - 128 | " |

# Fig. 3 - M3T DATA ACQUISITION
## Analog equipment

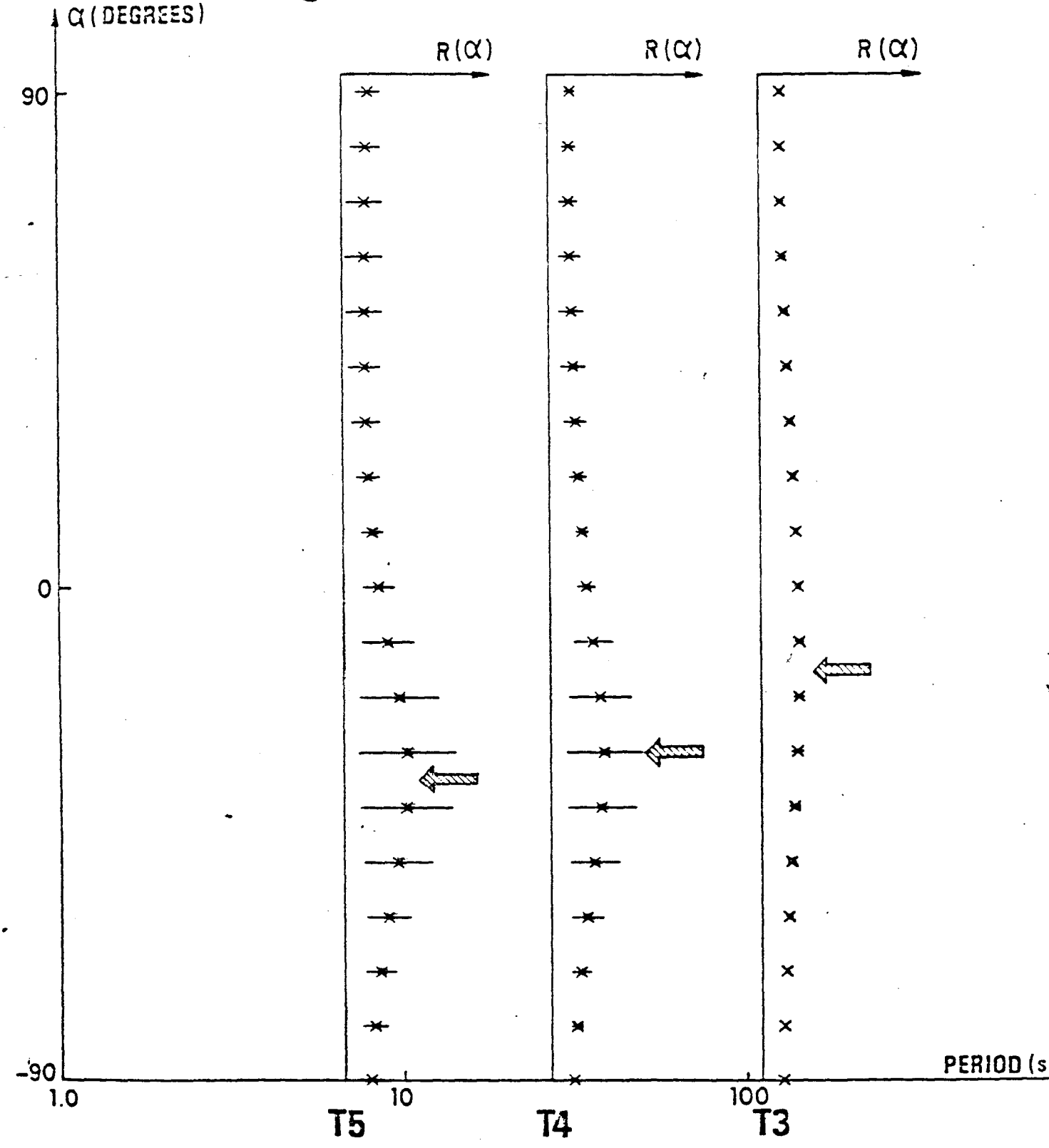
Fig. 4 - ANALOG RECORD OF LOW FREQUENCIES AND PLAYBACK.



# Fig. 5 - MAGNETOTELLURICS

## DETERMINATION OF MAIN GEOELECTRIC DIRECTIONS

(using the 3 magnetic components)



MODULE 3.125 VAL.

CENTRALE 1. AZIMUT DU MINIMUM 232°
MAXI 25.8 ANG ROT (MINIMUM) 20°

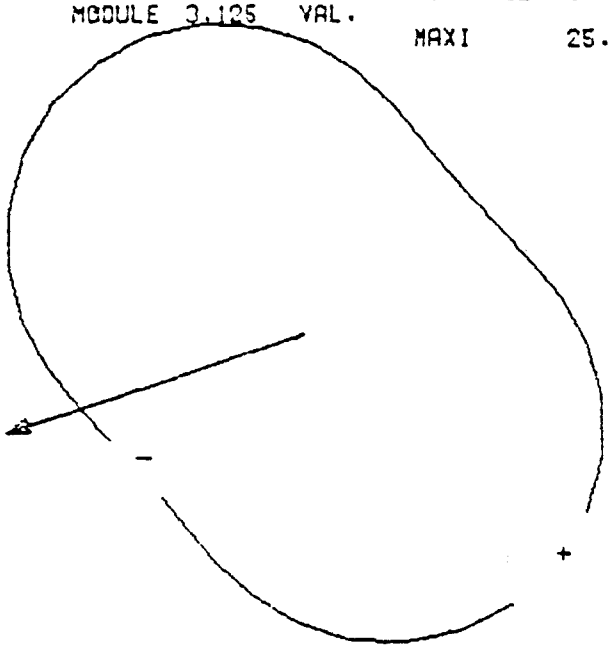
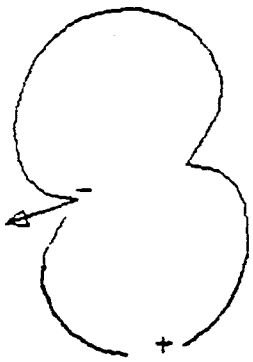



Fig.6
POLAR GRAPH

RHO XX

MODULE 0.761 VAL.

CENTRALE 0.01 AZIMUT DU MINIMUM 252°
MAXI 7.429 ANG ROT (MINIMUM) 0°




/ZXZ/

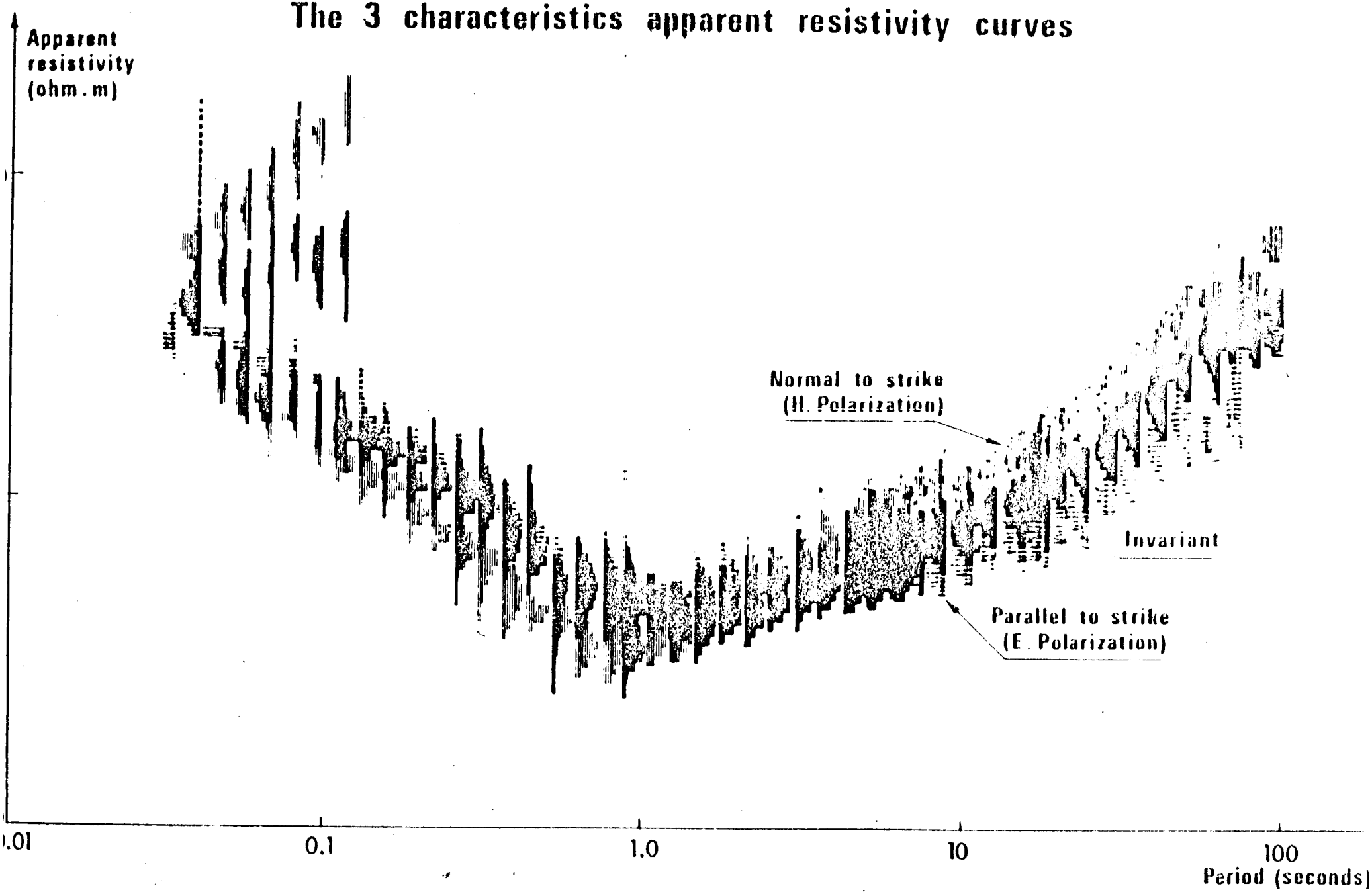
MODULE 3.125 VAL.

CENTRALE 0.1 AZIMUT DU MINIMUM 162°
MAXI 0.72 ANG ROT (MINIMUM) 90°

Fig. 7

# MAGNETOTELLURICS

## The 3 characteristics apparent resistivity curves



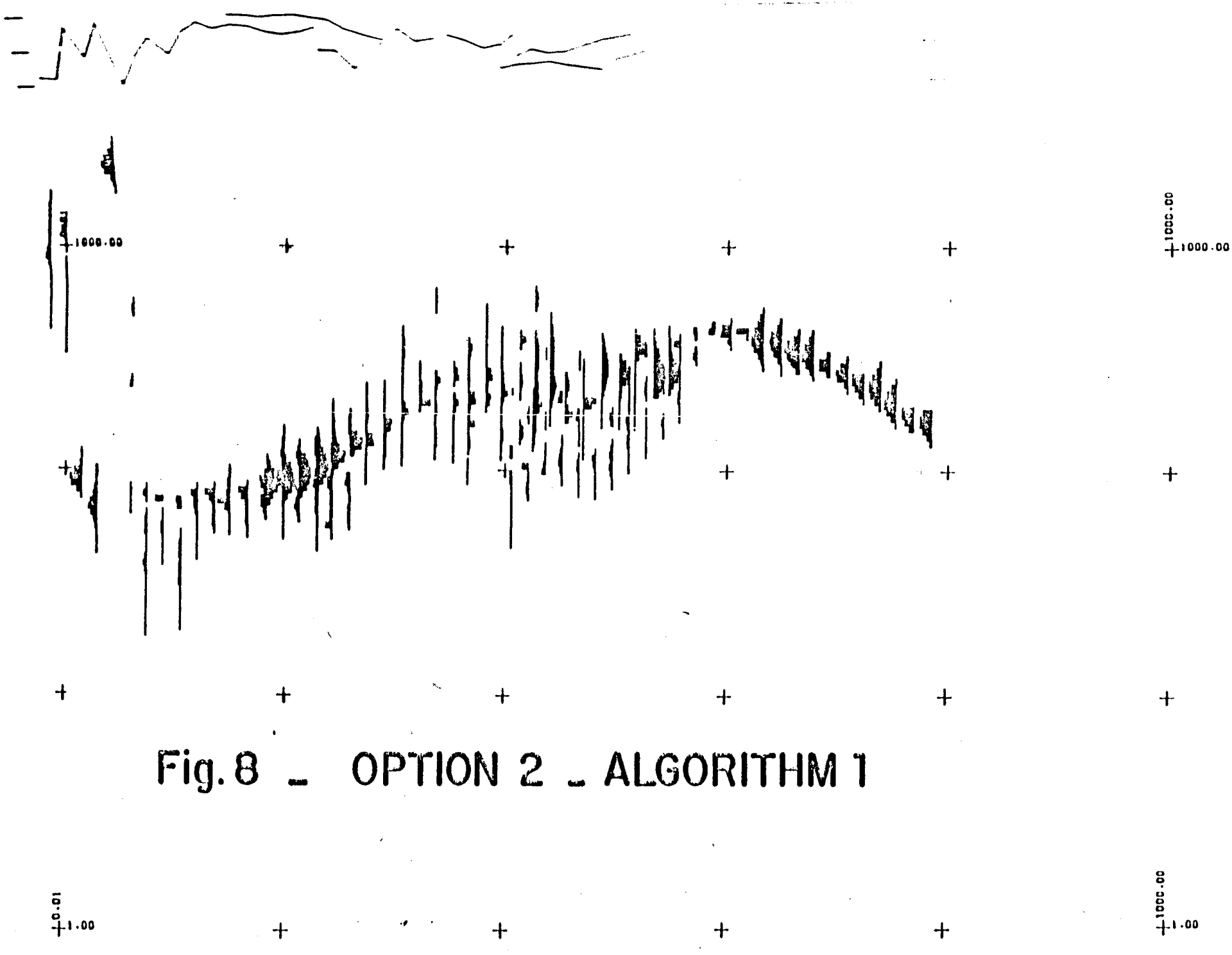



Fig. 8 - OPTION 2 - ALGORITHM 1

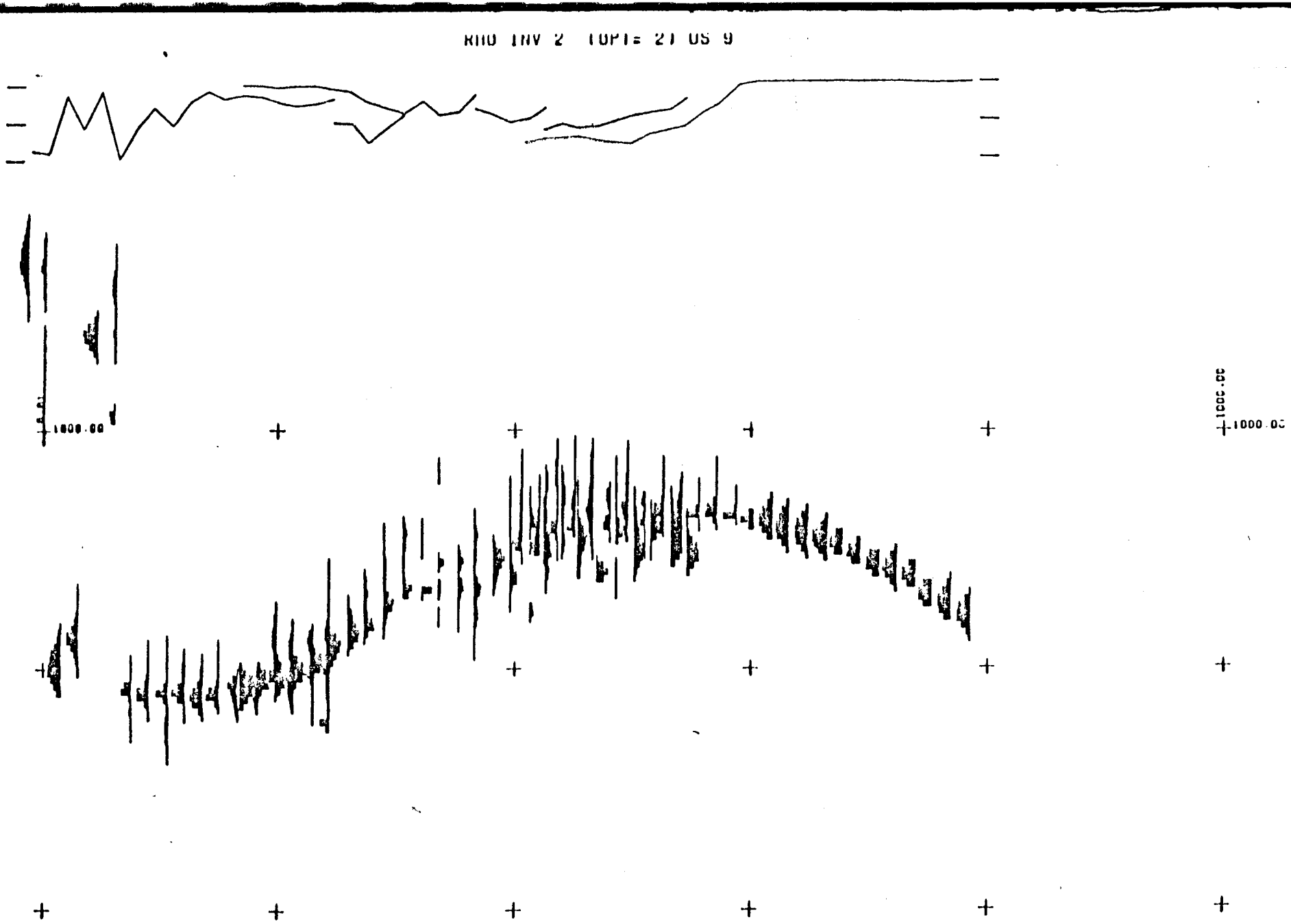



Fig.9 _ OPTION 2 _ ALGORITHM 2

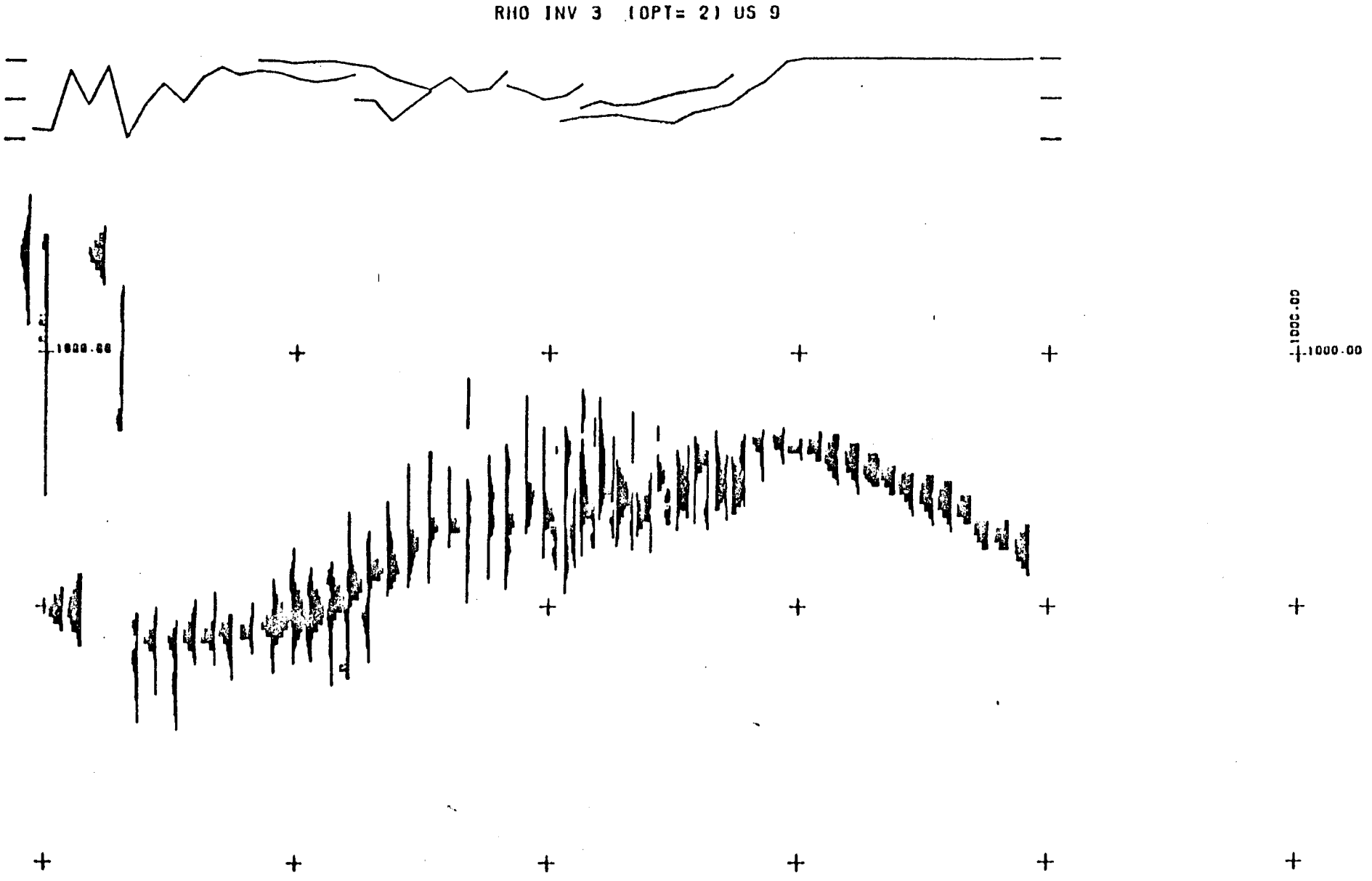
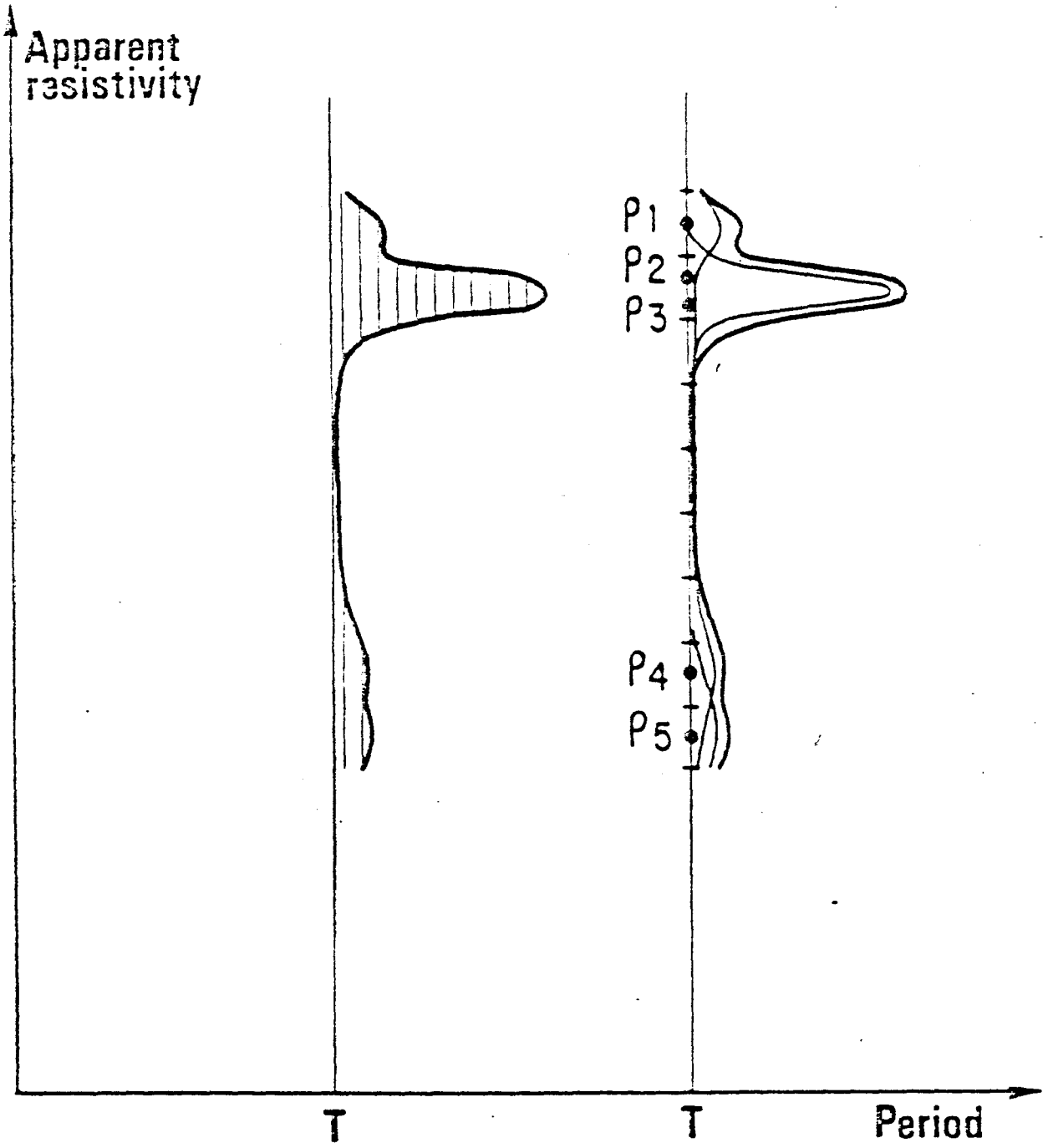



Fig.10 _ OPTION 2 _ ALGORITHM 3

Fig. 11 - PLOTTING OF APPARENT RESISTIVITY VALUES.



# Fig. 12 _ MAGNETOTELLURICS

## Computerized interpretation of a MT curve

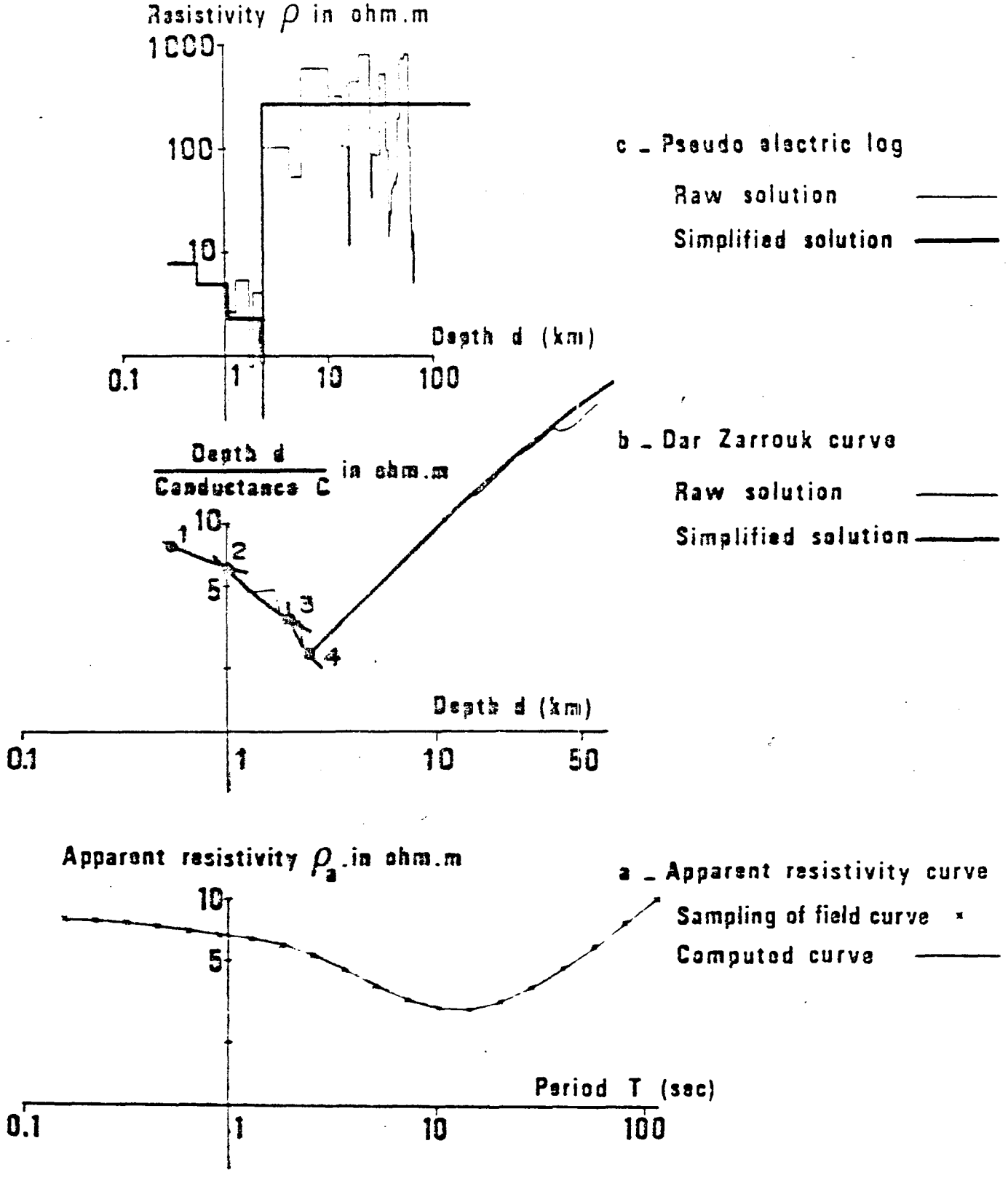
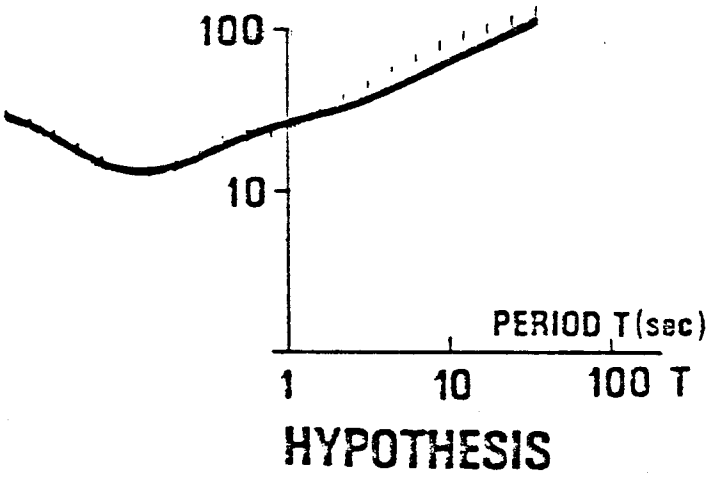


Fig. 13 – MAGNETOTELLURICS

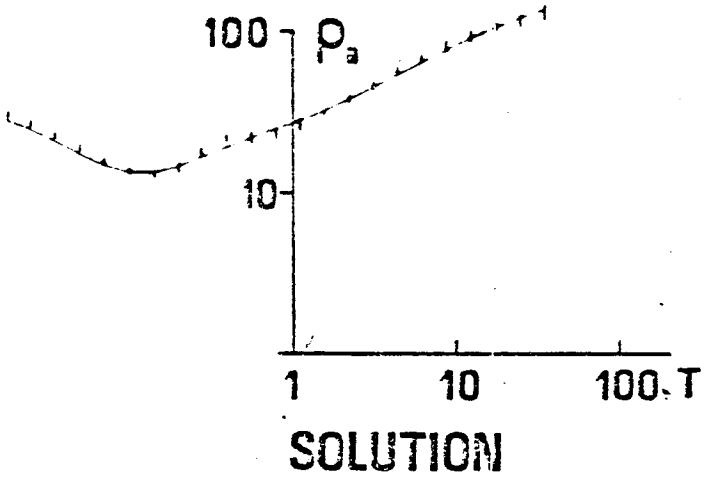
# COMPUTERIZED ADJUSTMENT OF A HYPOTHETICAL SOLUTION

APPARENT RESISTIVITY

$\rho_a$ in ohm.m




HYPOTHESIS




SOLUTION

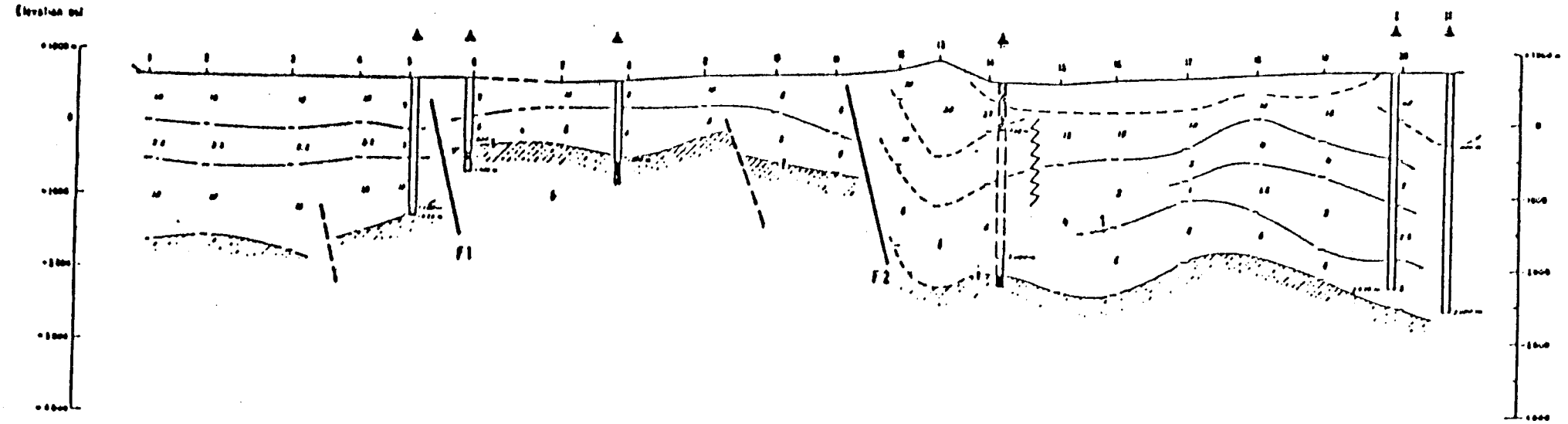
– Sampling of field curve

– Proposed hypothetical curve

– Computed adjusted curve

# Fig.14 _ MAGNETOTELLURICS : Case history

## STRUCTURAL INTERPRETATION




Approximate location of tectonic features (after geologic map)

LEGEND

ill and depth to the resistive electric basement

Sounding and its number

ictric terrain and its resistivity

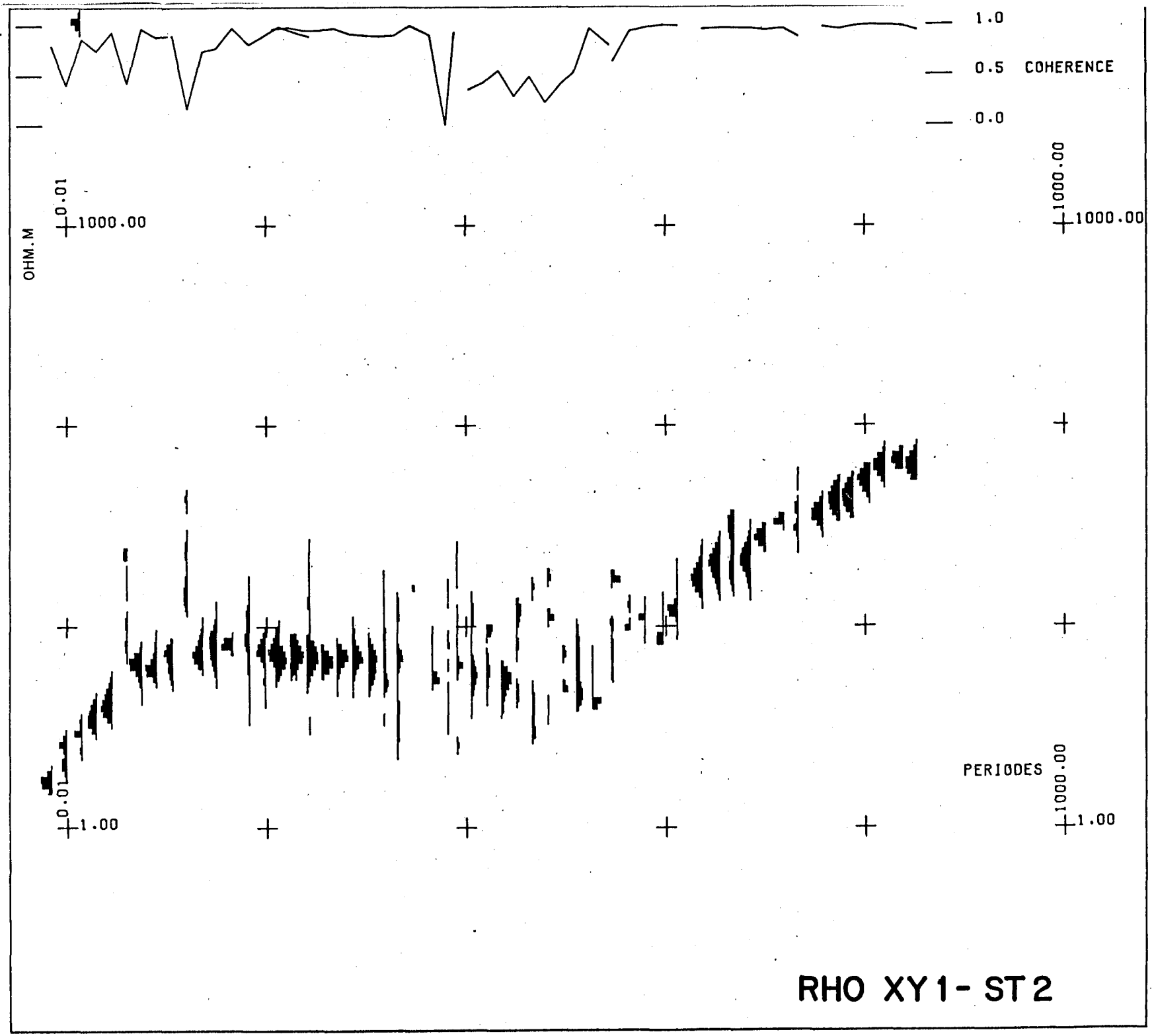
sistive electric basement

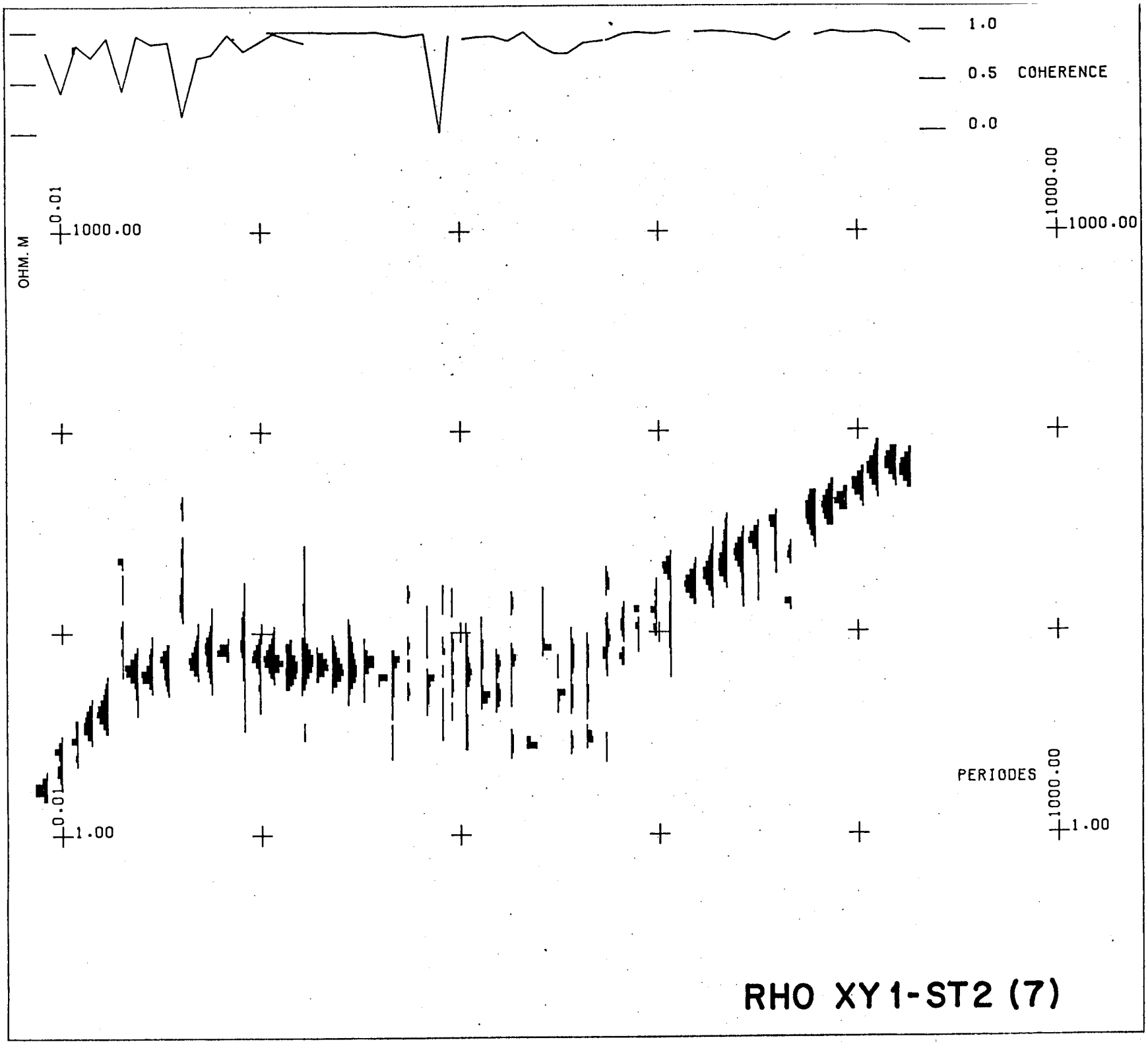
ult or front of overthrust , supposed fault

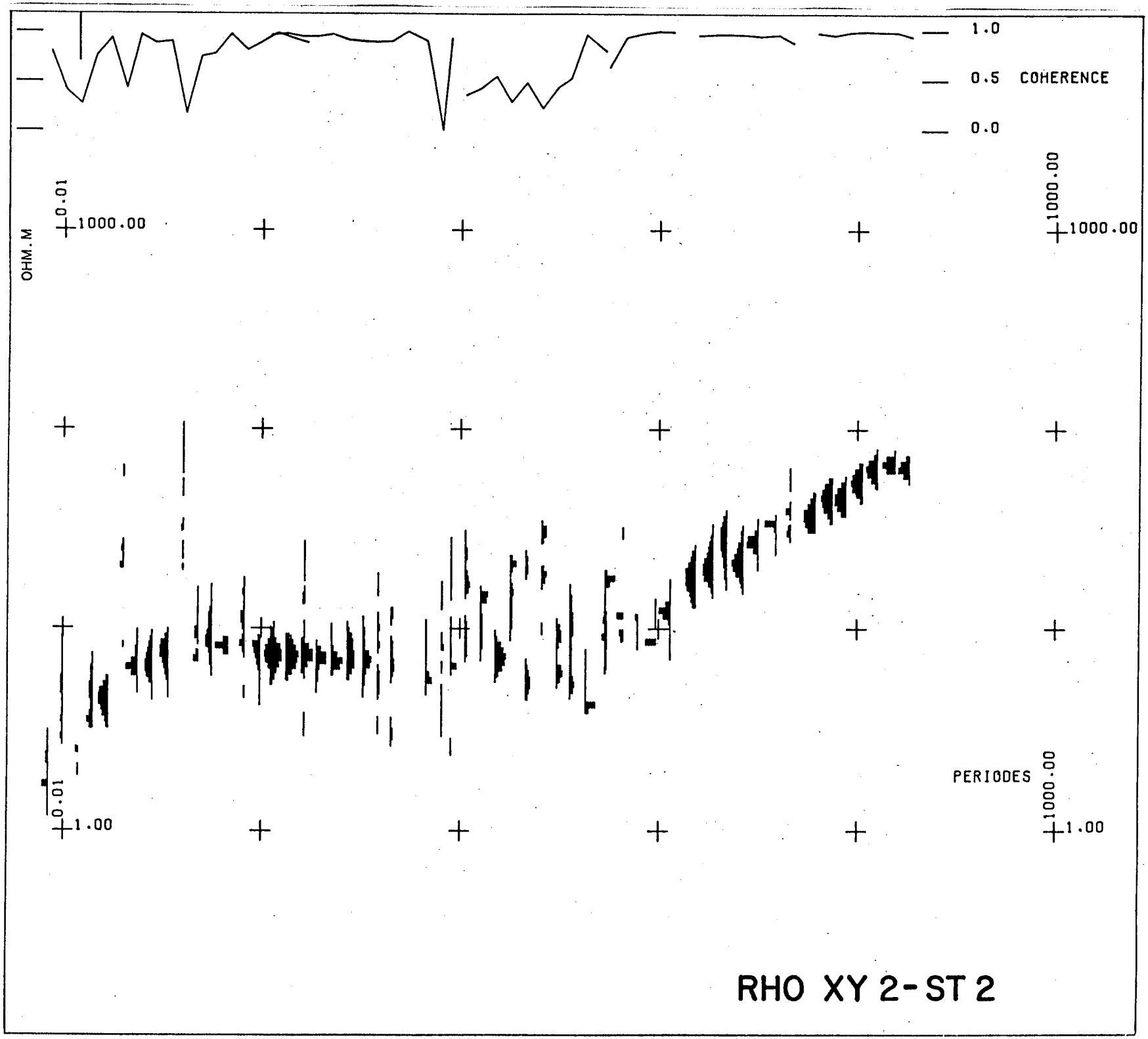
sistivity discontinuity

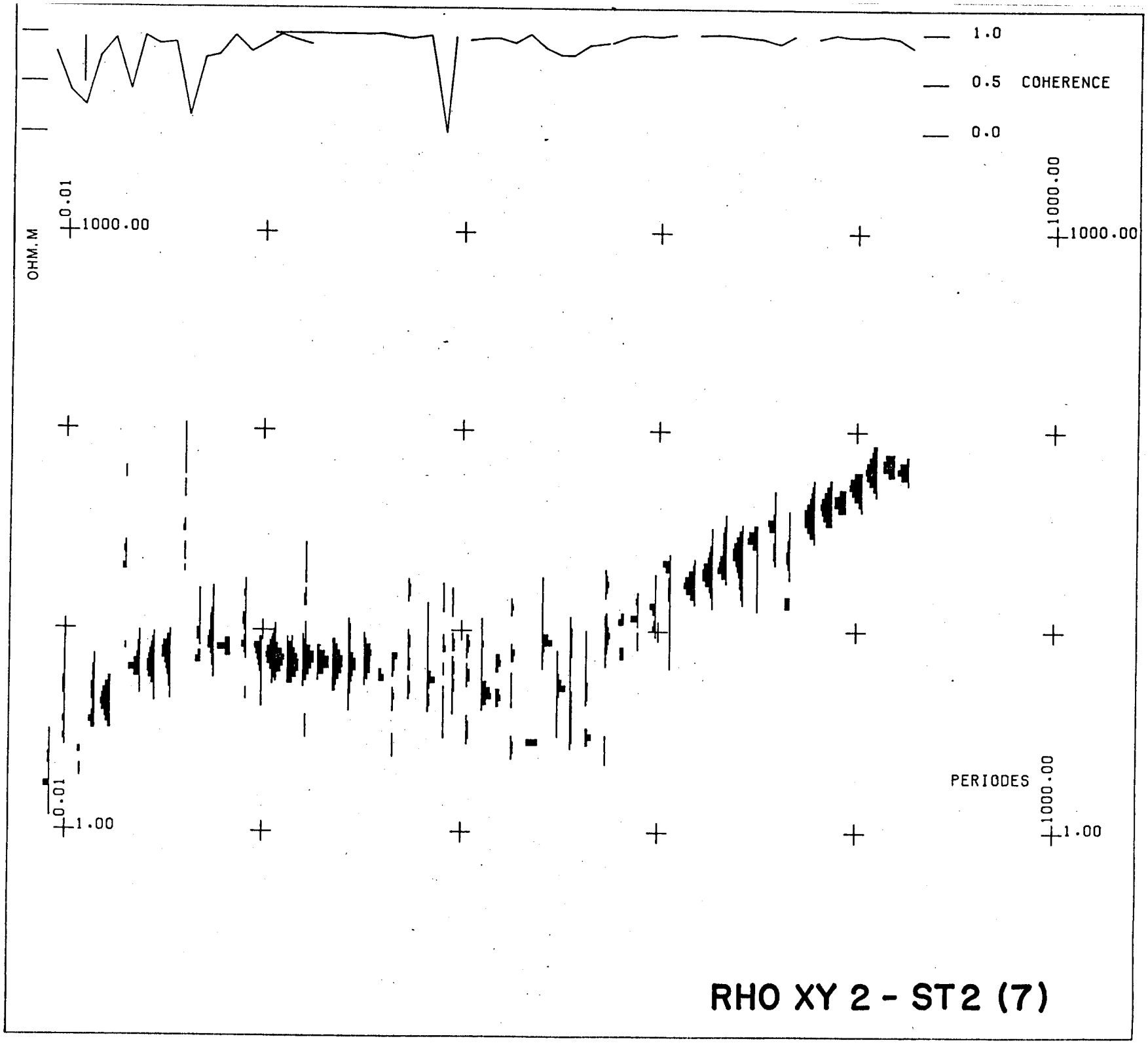
roleum objective

2Km

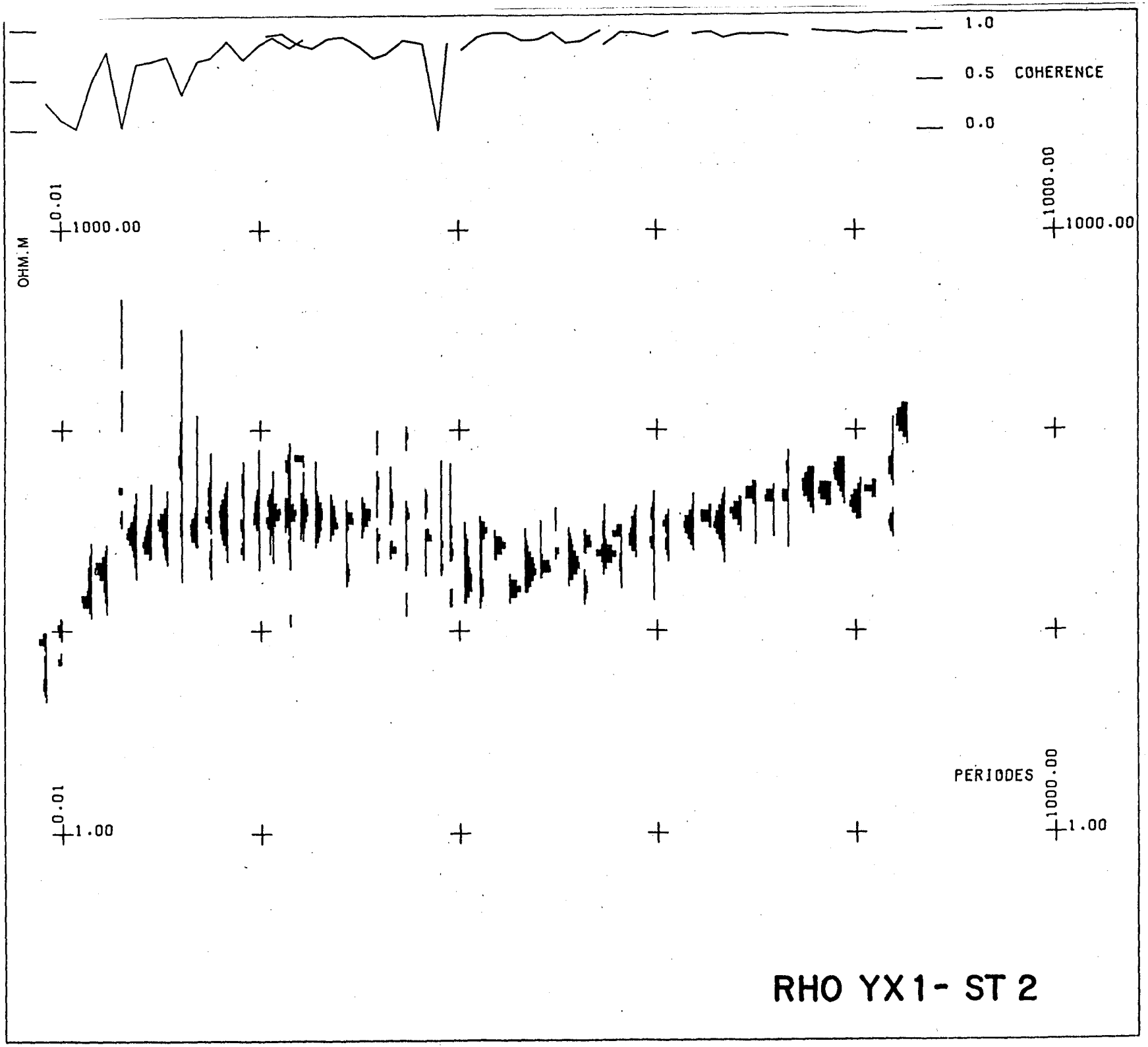

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO XY1- ST2

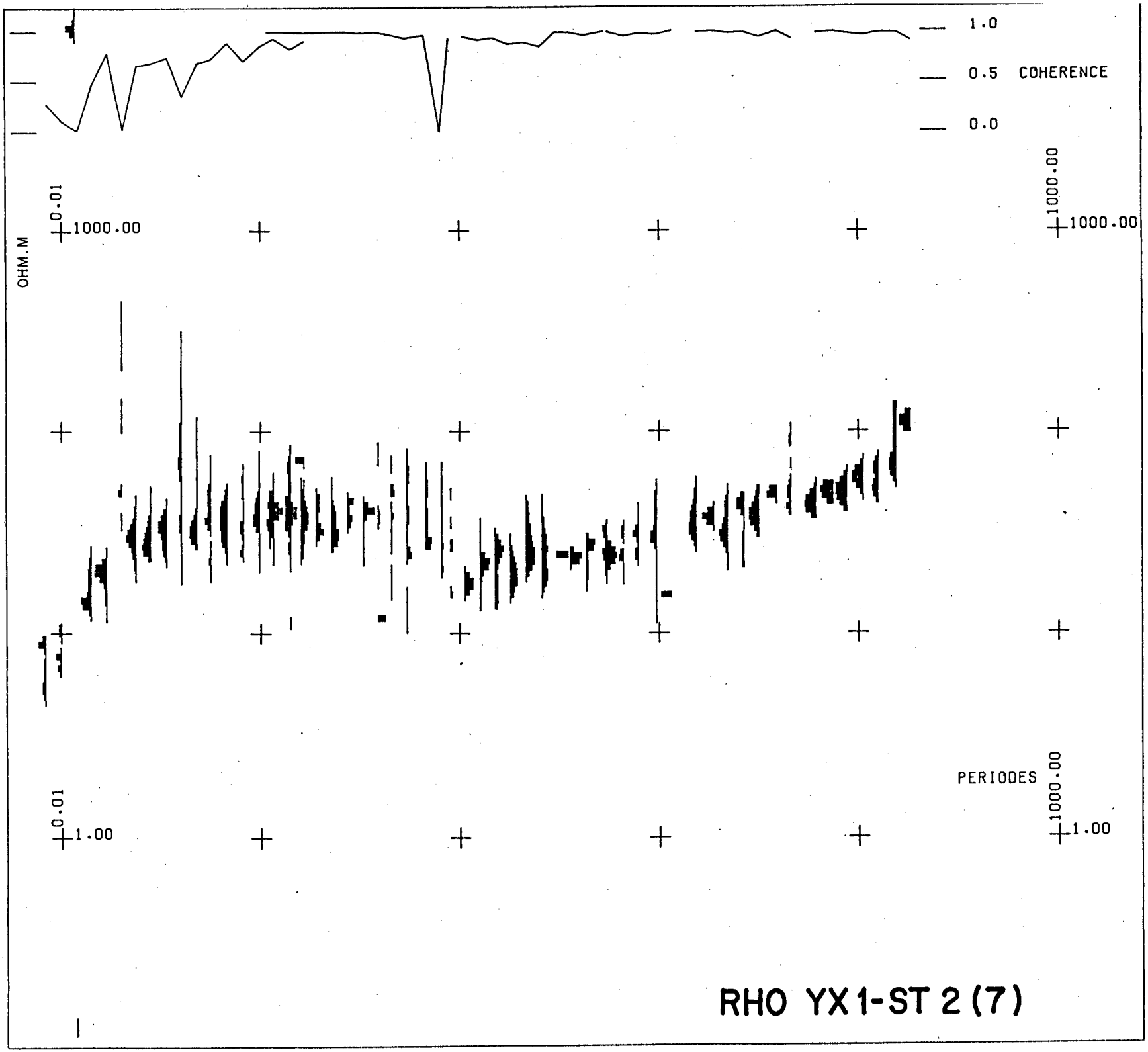

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
0.01
1.00
PERIODES
1000.00
1.00
RHO XY1-ST2 (7)

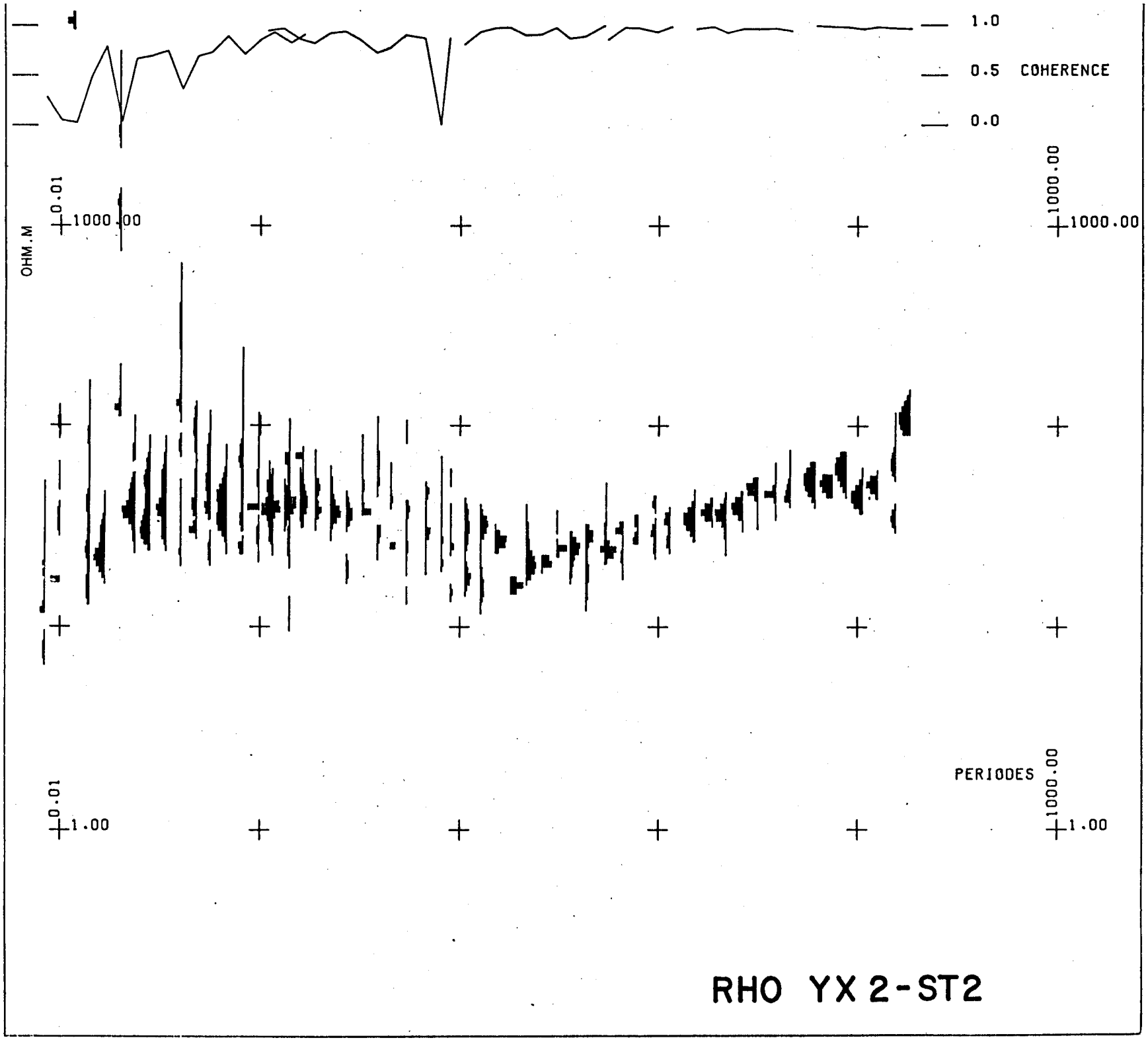

1.0
0.5 COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO XY 2-ST 2

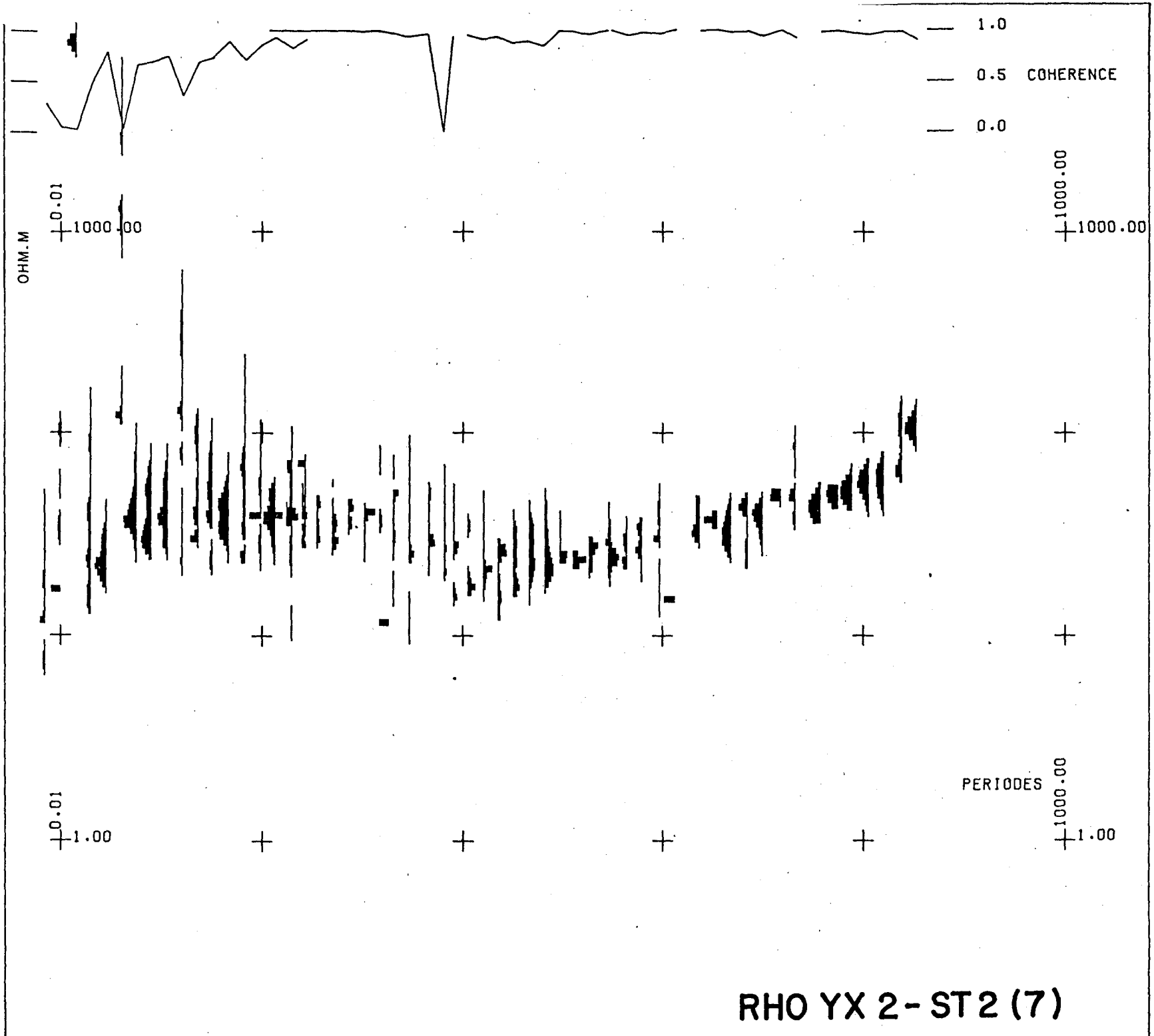

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00

RHO XY 2 - ST2 (7)

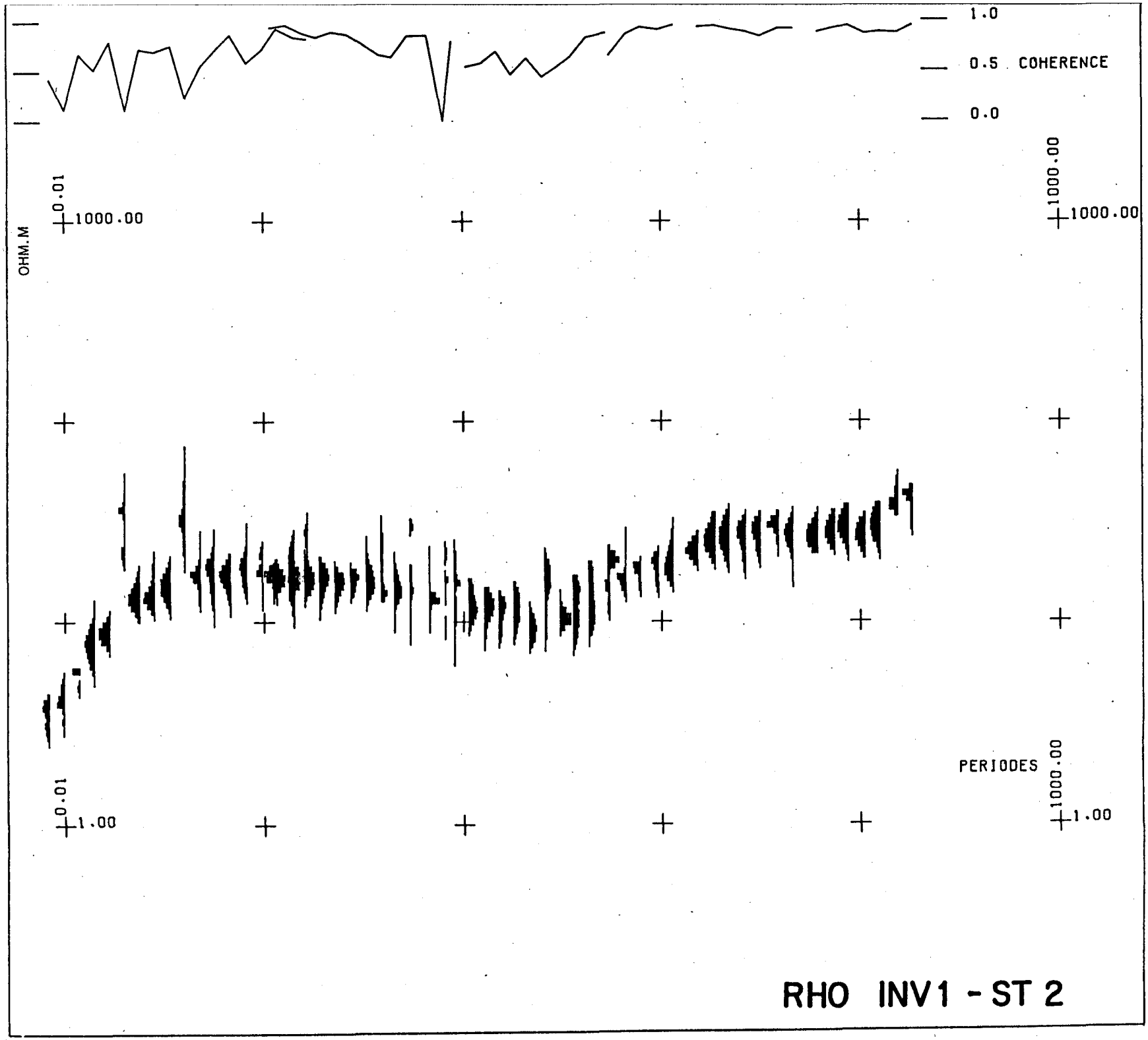

1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO YX1- ST 2

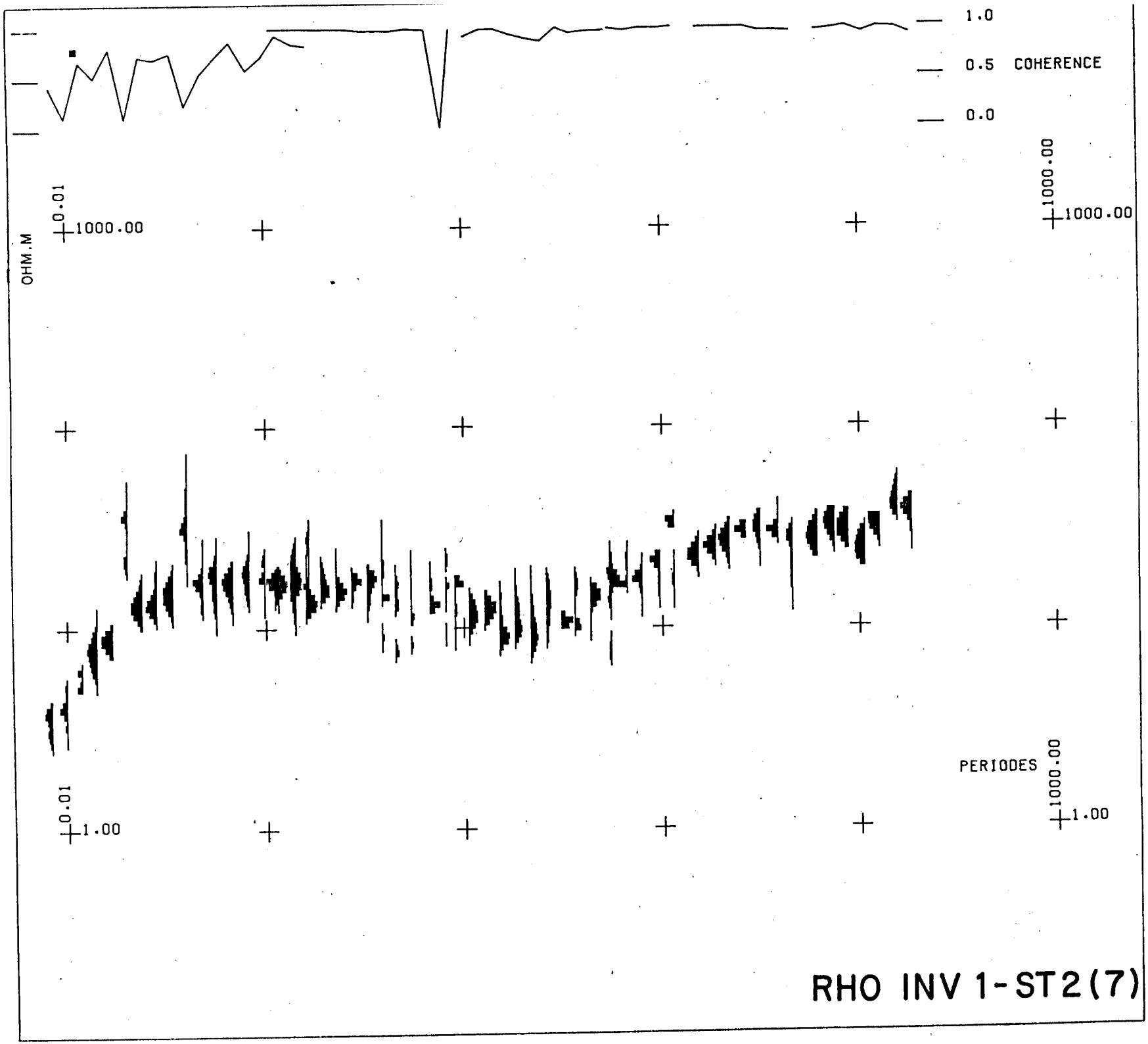

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO YX1-ST 2 (7)

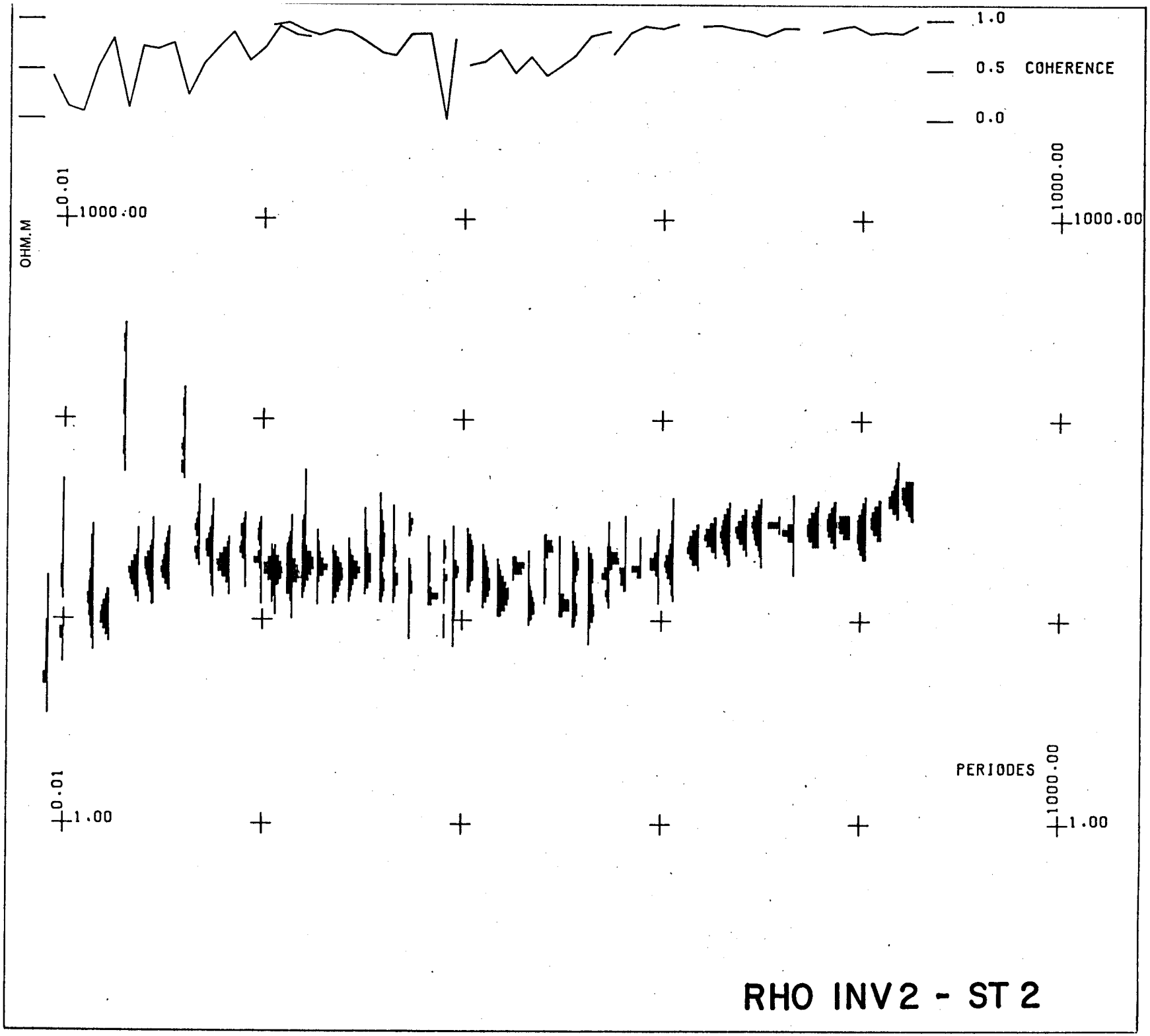

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO YX 2-ST2

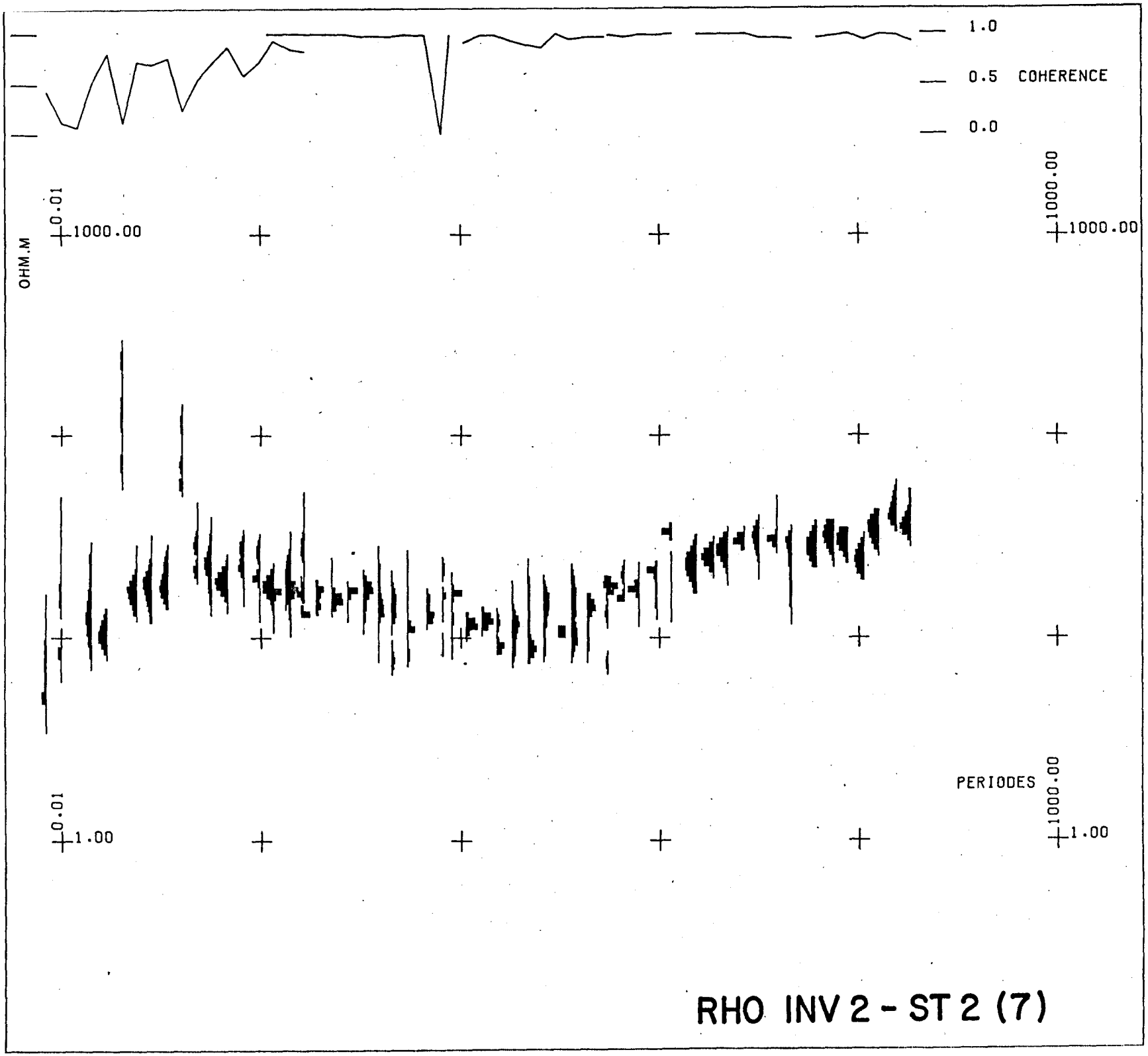

1.0
0.5
COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00

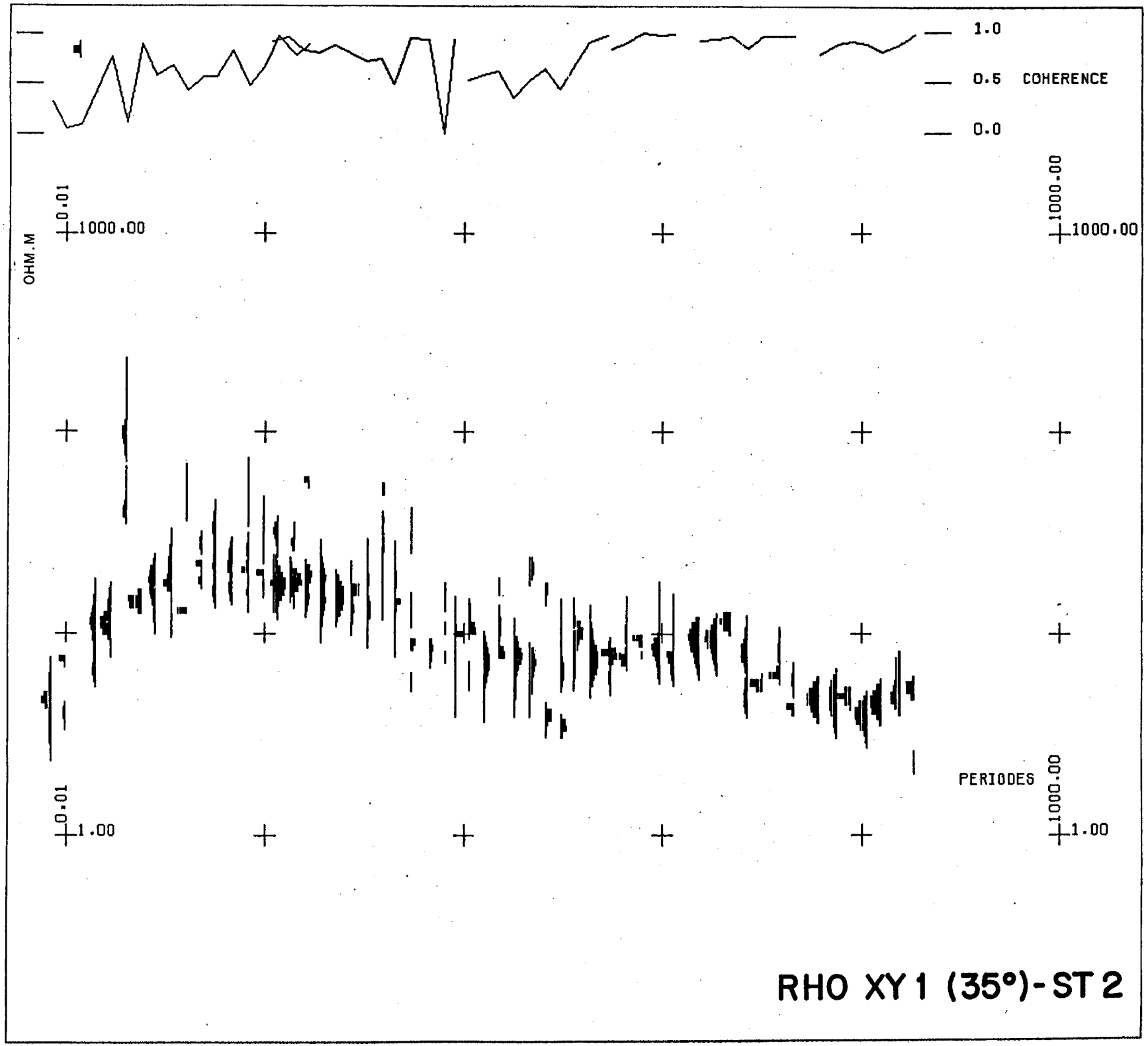
RHO YX 2 - ST 2 (7)


1.0
0.5 COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO INV1 - ST 2

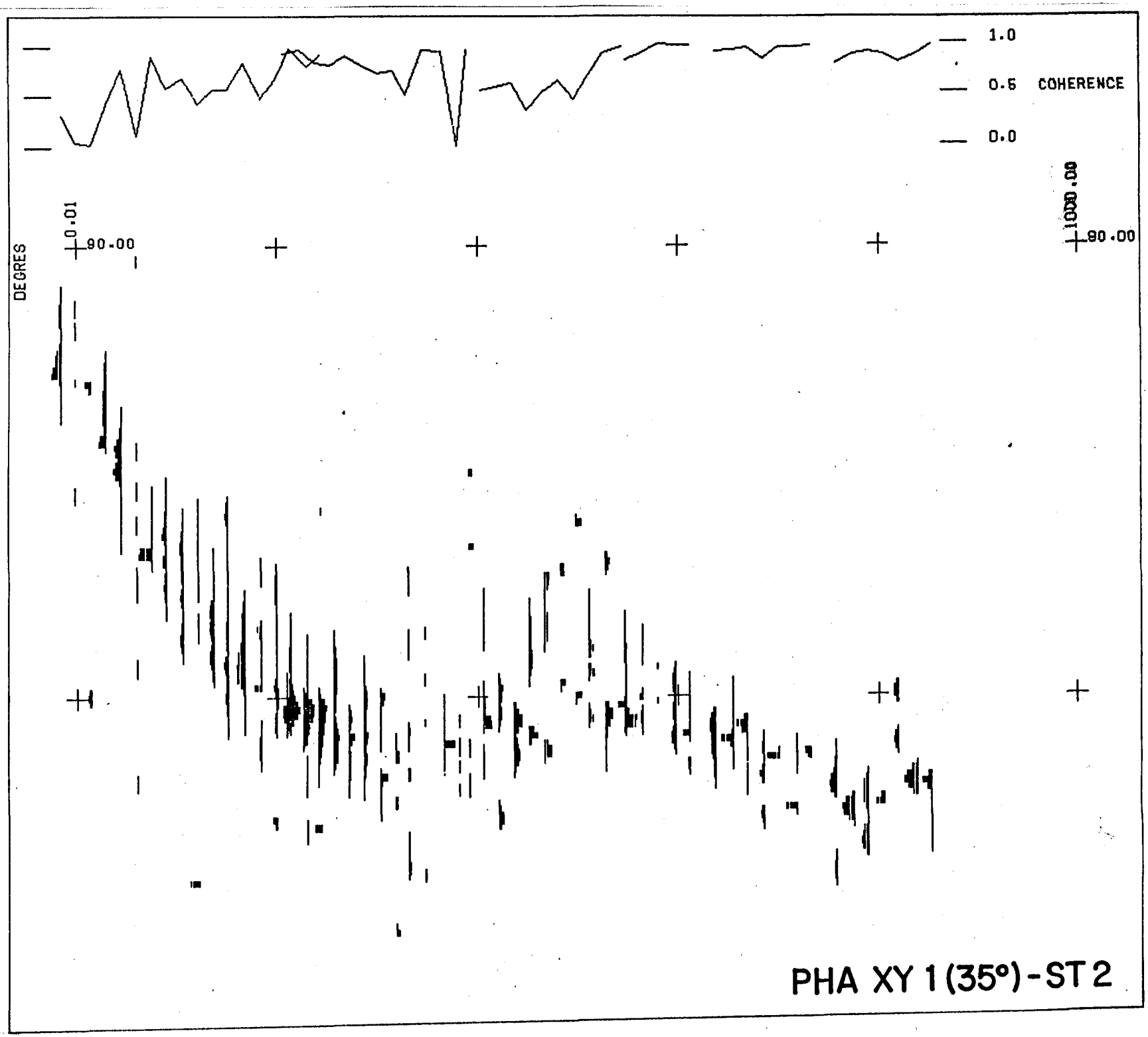

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO INV 1-ST2(7)

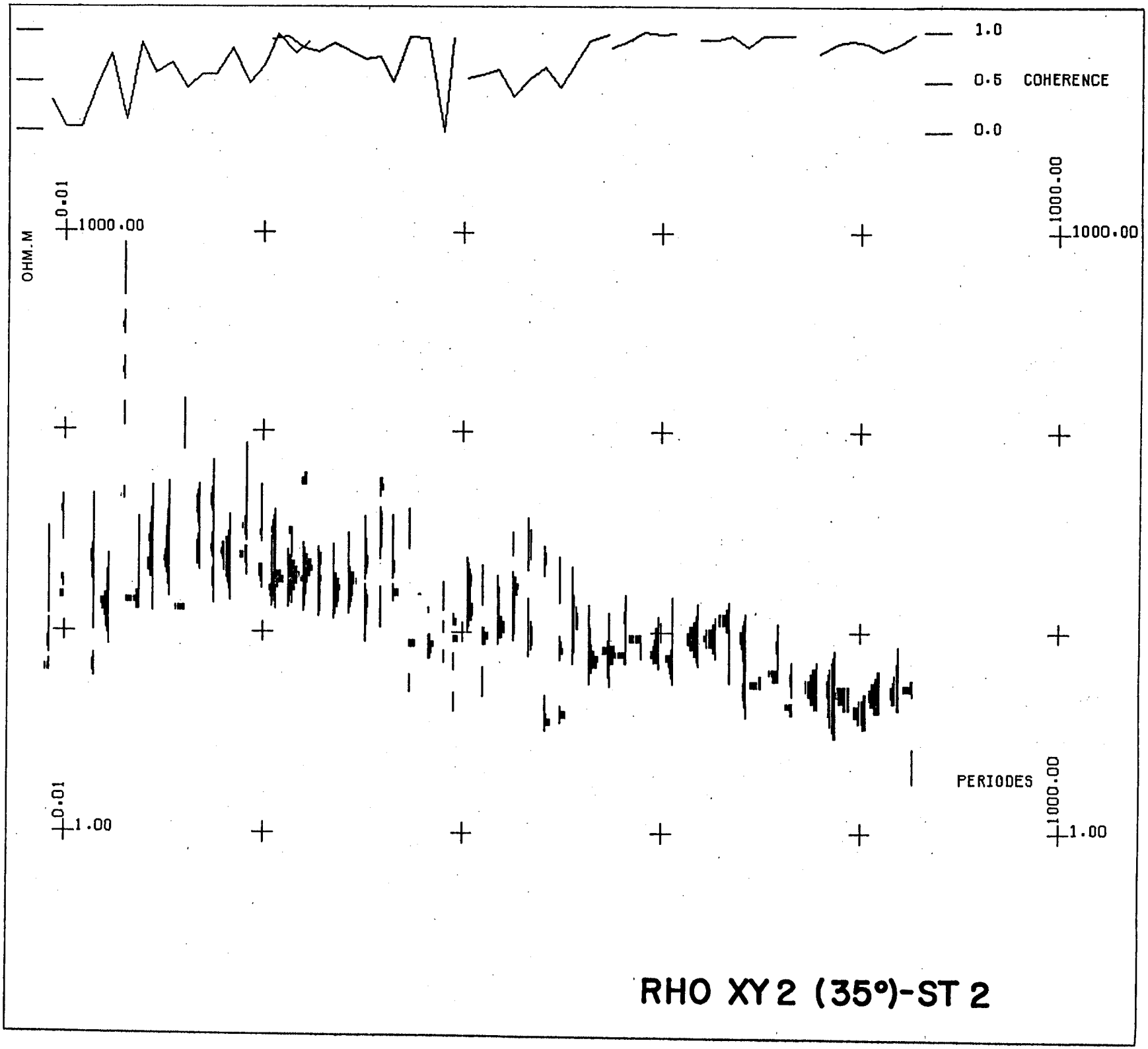

1.0
0.5 COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO INV2 - ST 2

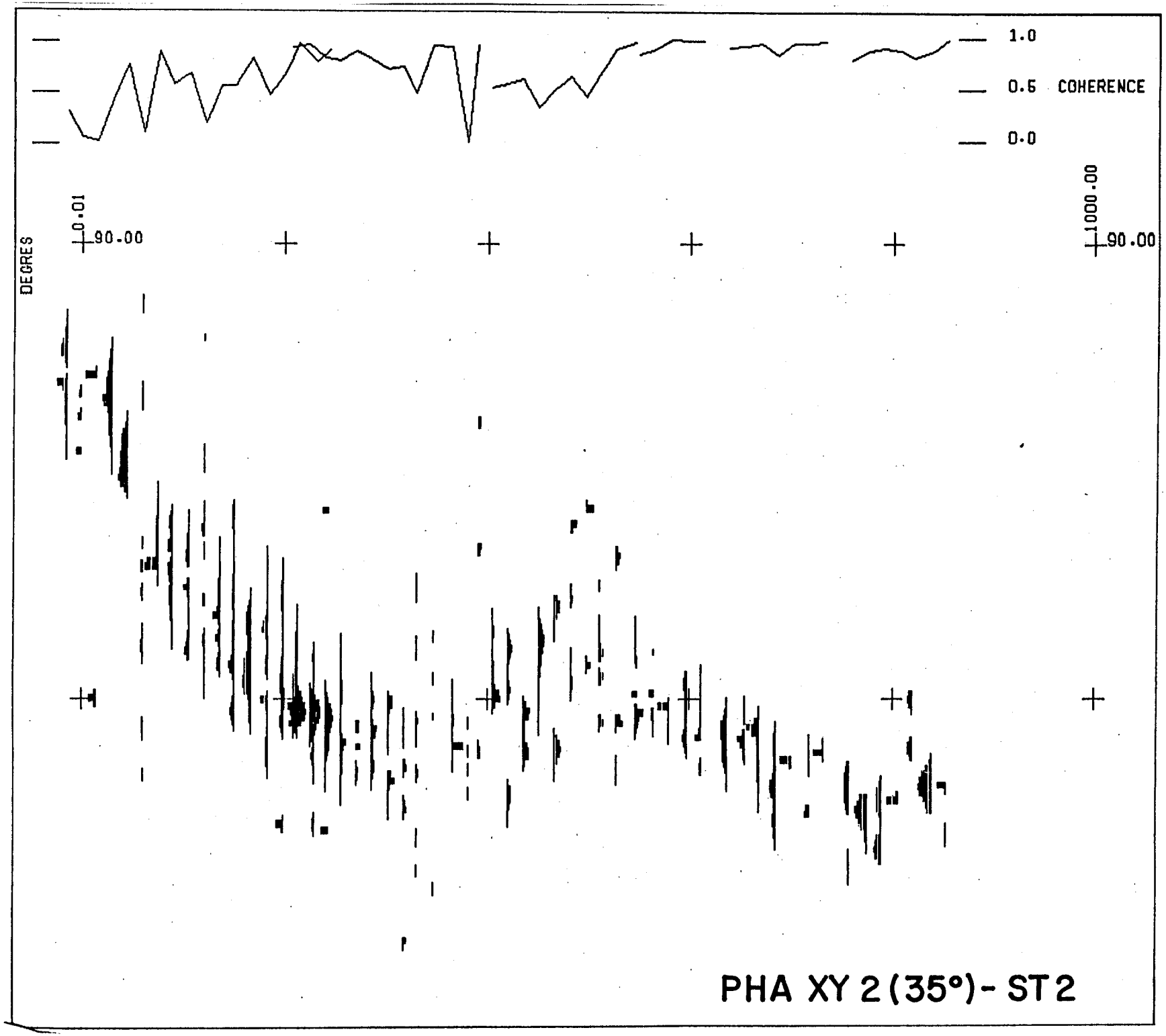

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO INV 2 - ST 2 (7)

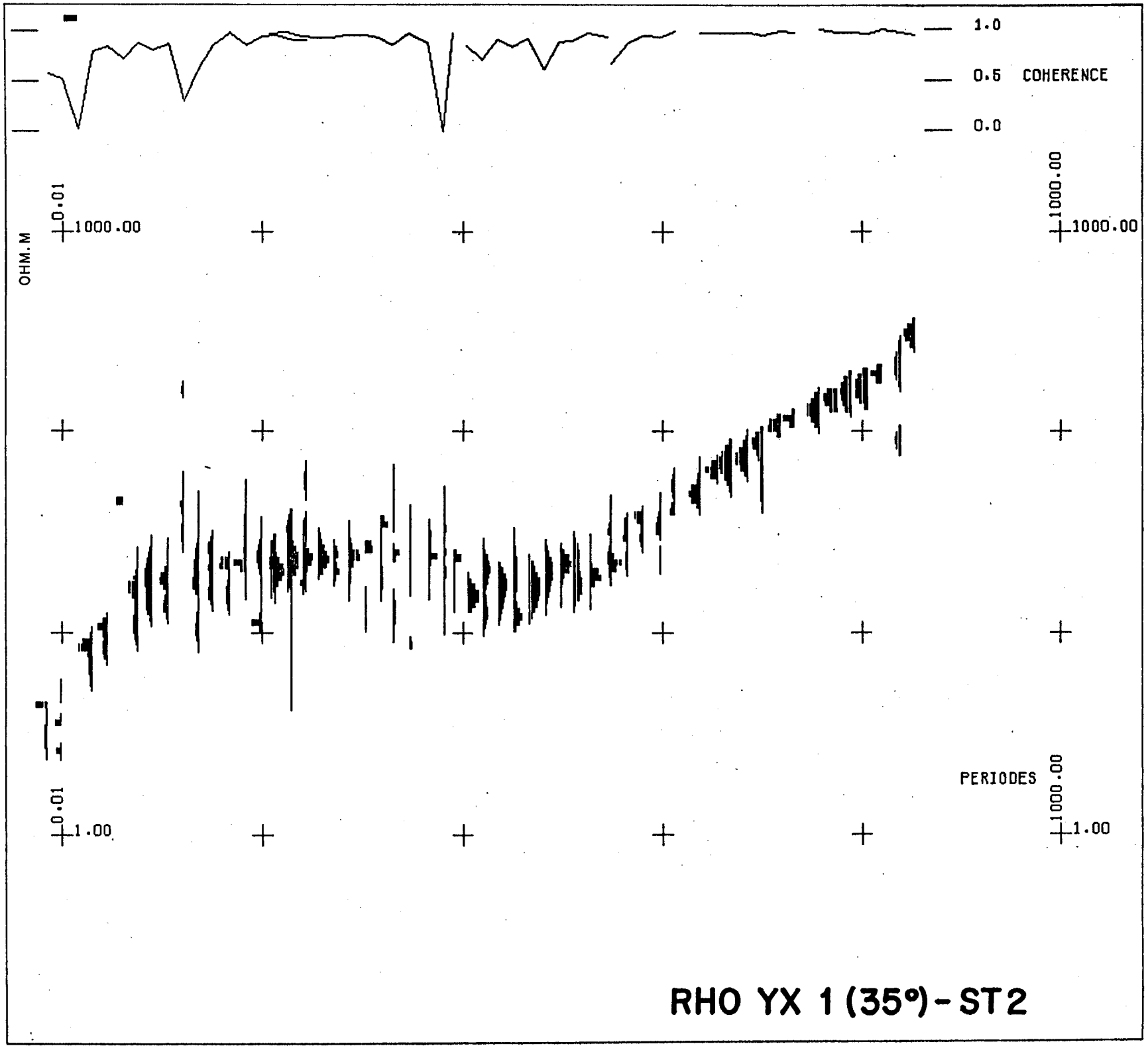


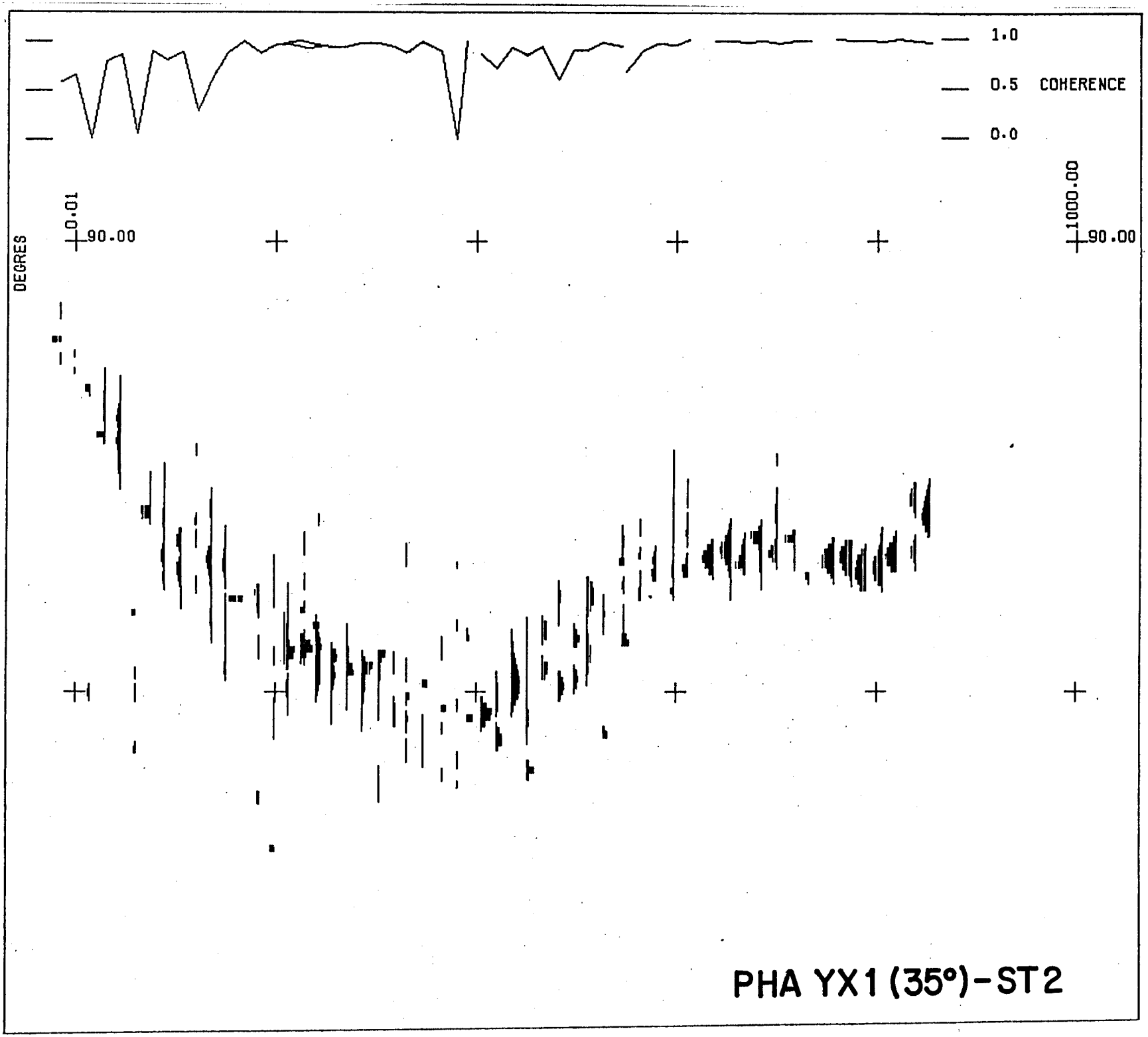

RHO XY 1 (35°)-ST 2

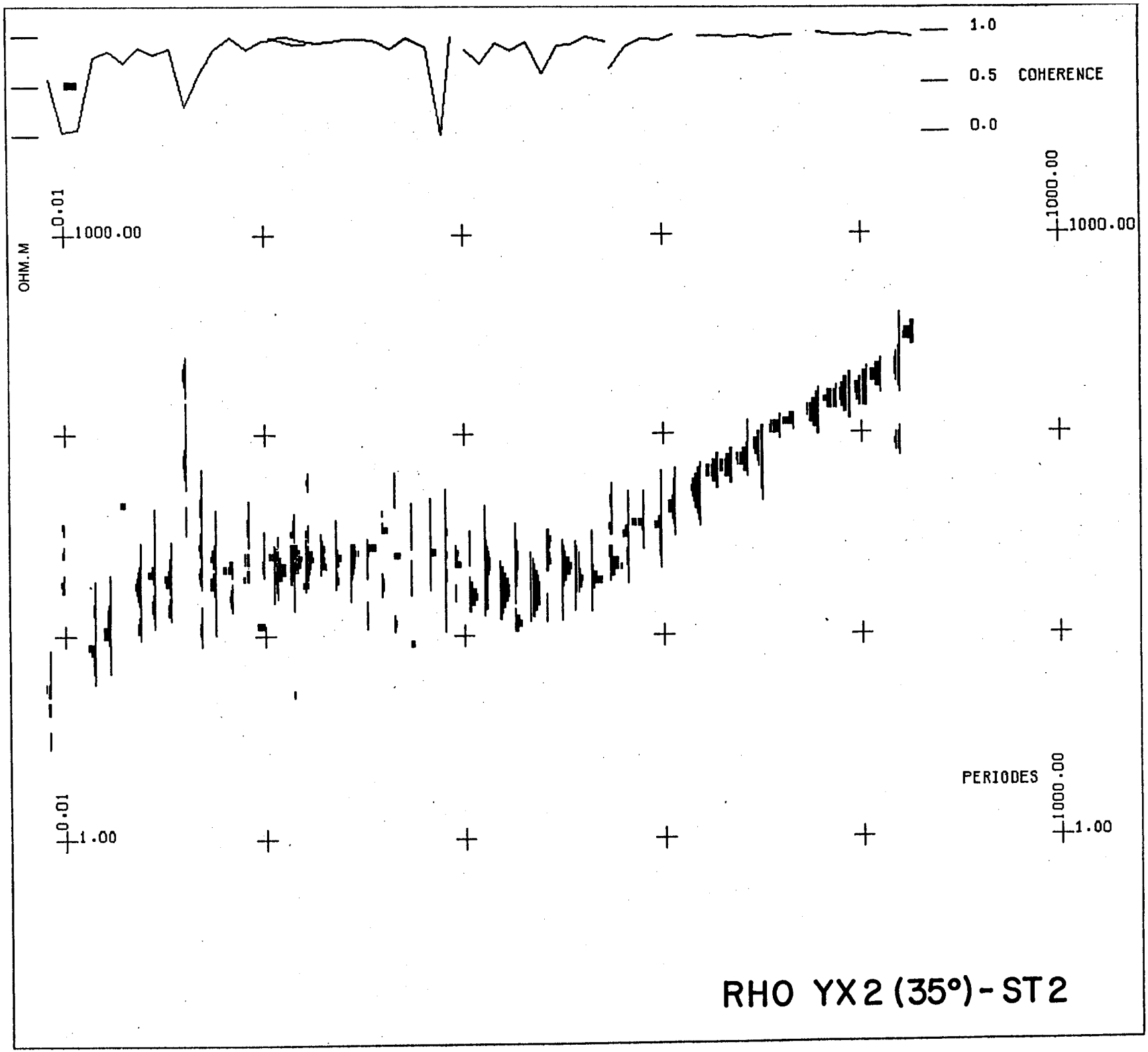

1.0
0.5
COHERENCE
0.0
0.01
90.00
DEGREES
90.00
PHA XY 1(35°)-ST 2

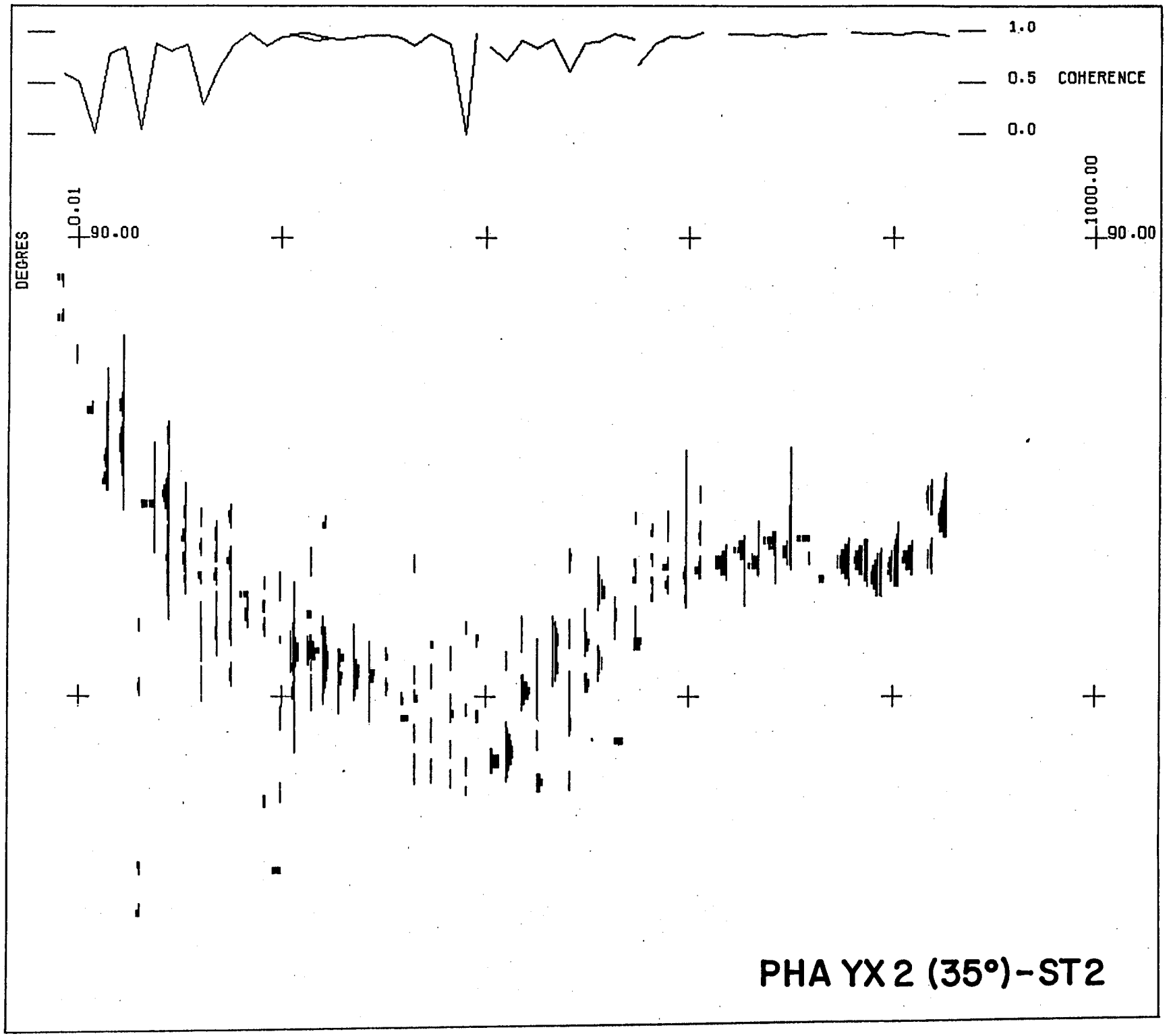

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO XY 2 (35°)-ST 2

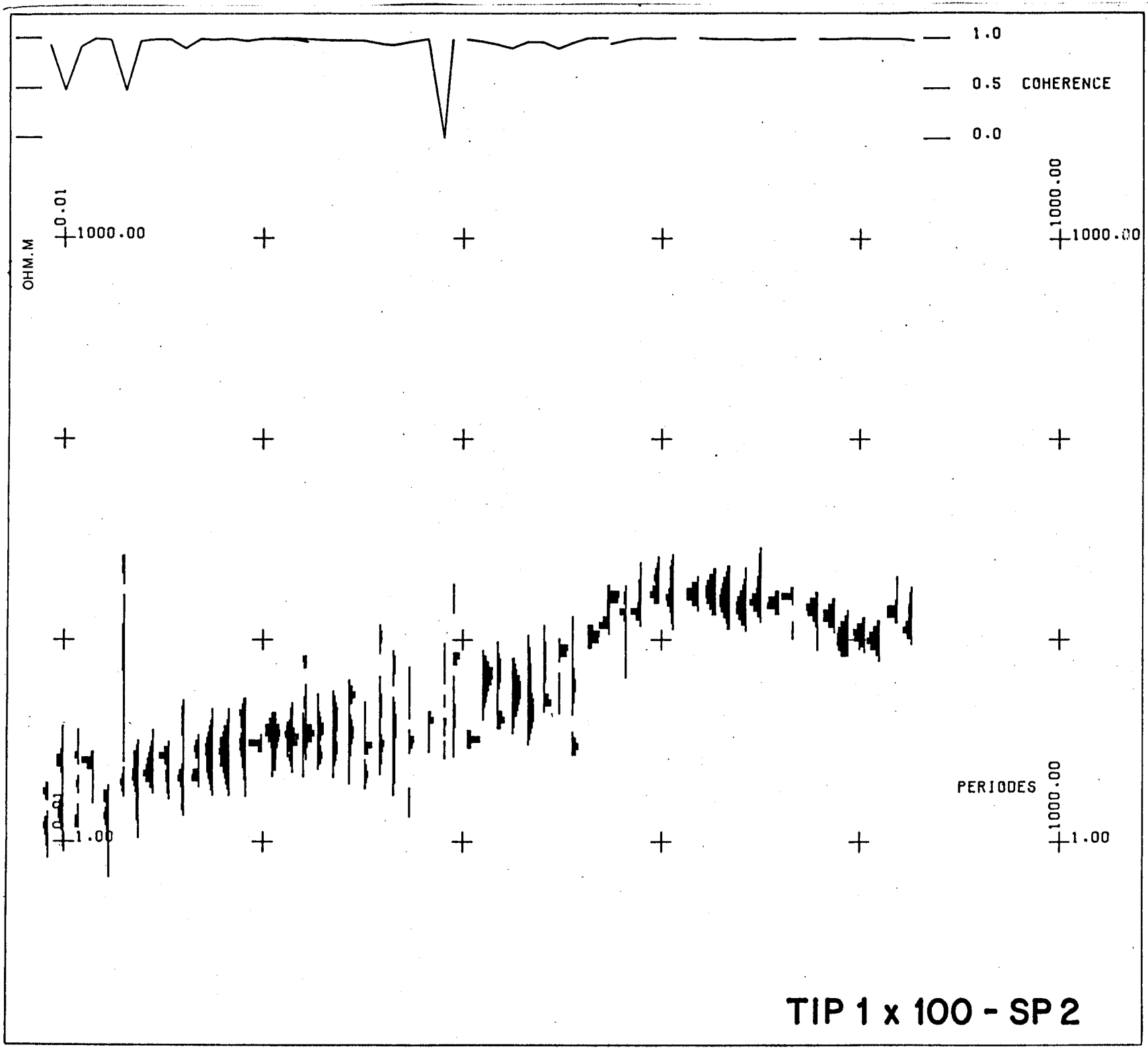

1.0
0.5
COHERENCE
0.0
0.01
90.00
DEGRES
1000.00
90.00
PHA XY 2 (35°) - ST 2

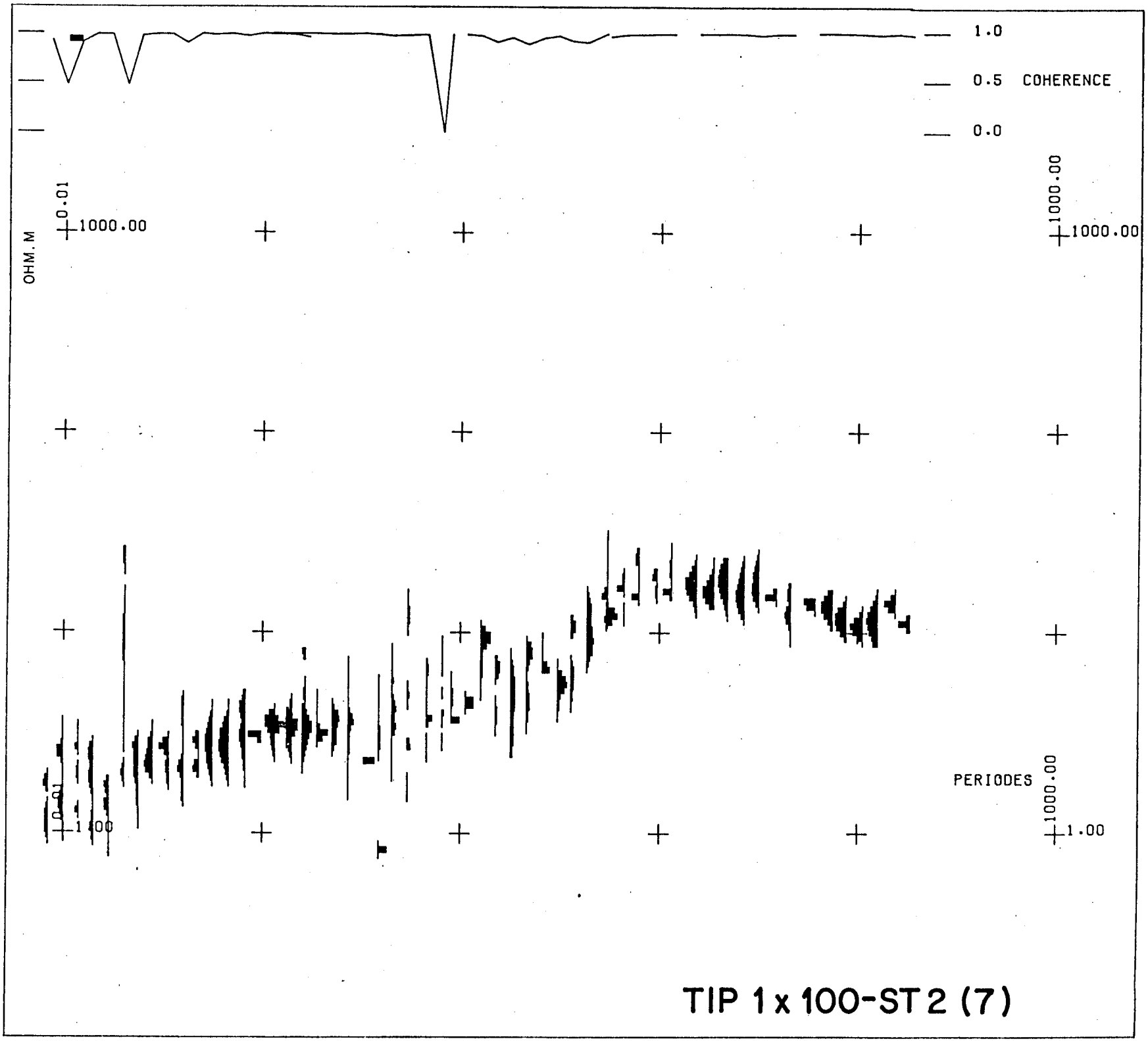

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO YX 1 (35°) - ST2

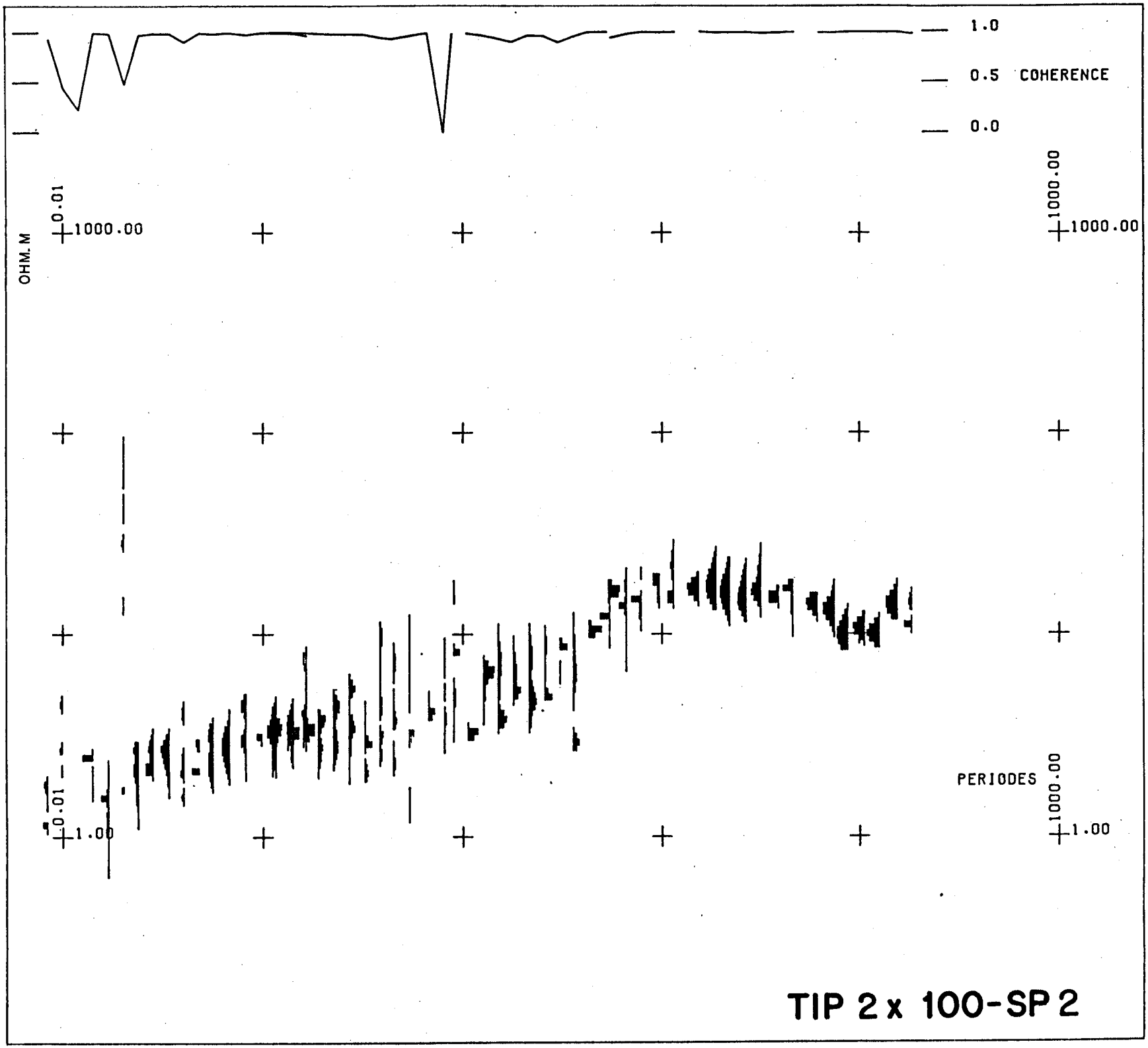

1.0
0.5
COHERENCE
0.0
DEGRES
0.01
90.00
1000.00
90.00
PHA YX1 (35°)-ST2

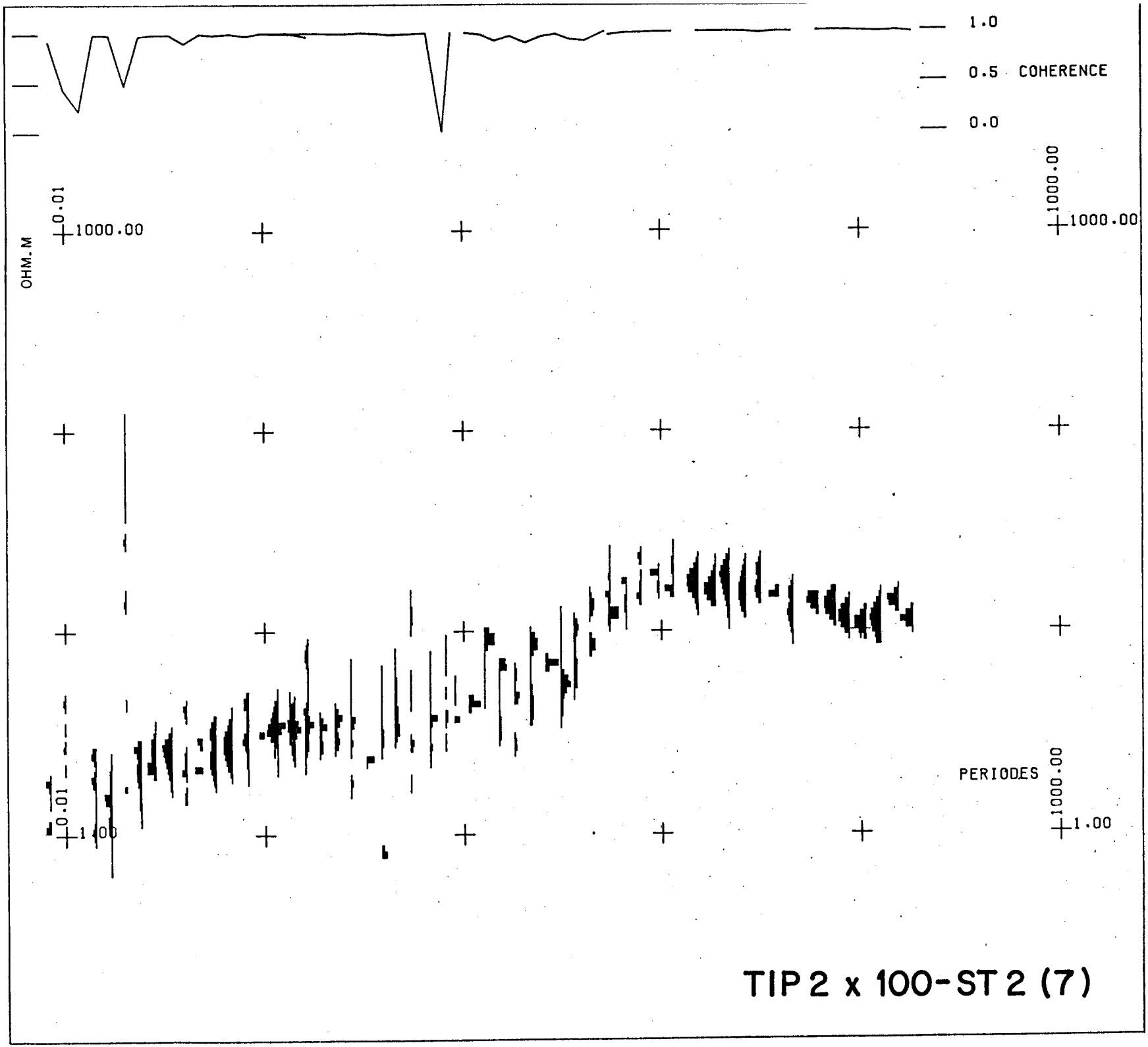

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
RHO YX2 (35°) - ST2

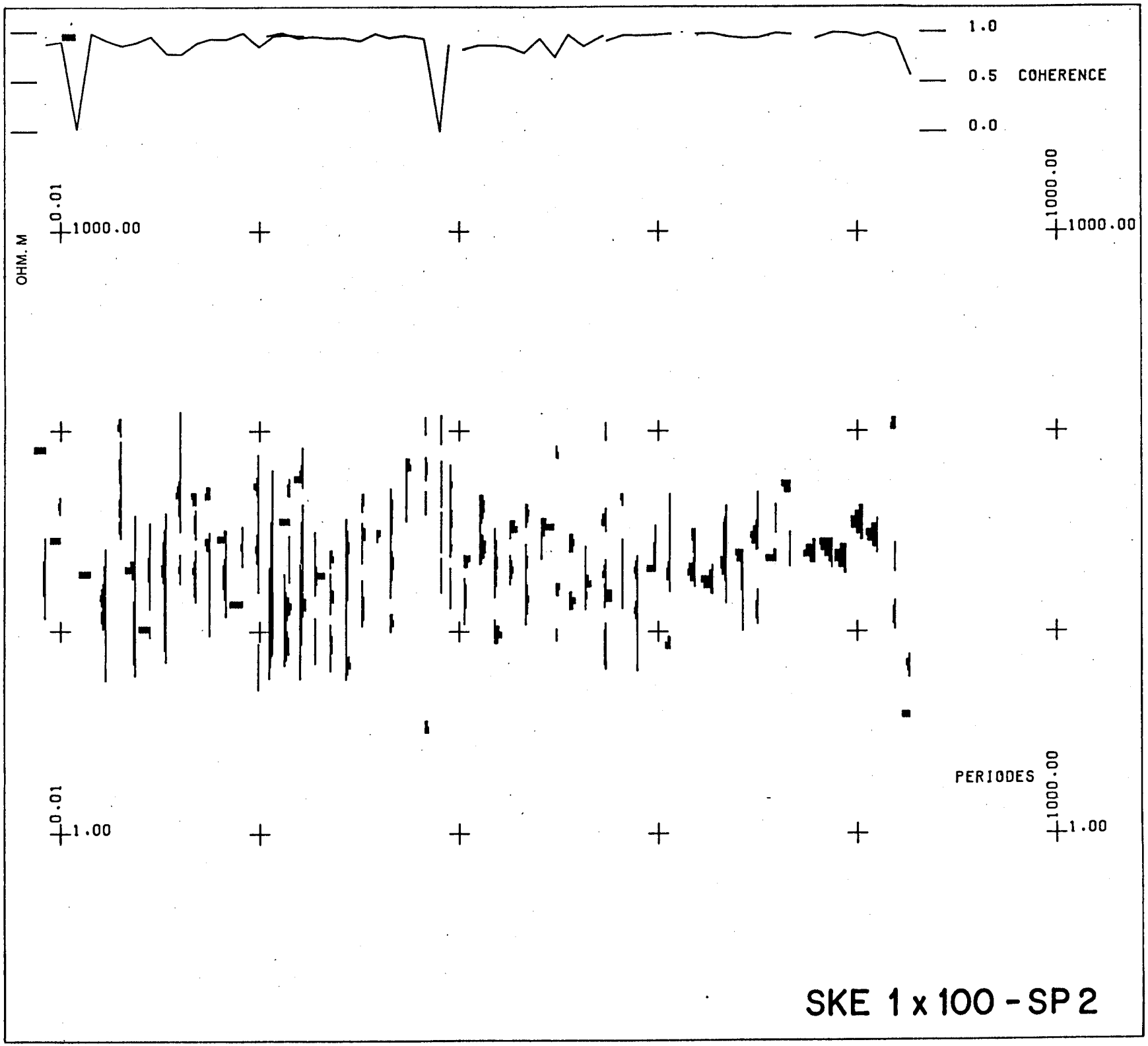

1.0
0.5
COHERENCE
0.0
0.01
90.00
1000.00
90.00
DEGRES
PHA YX 2 (35°)-ST2

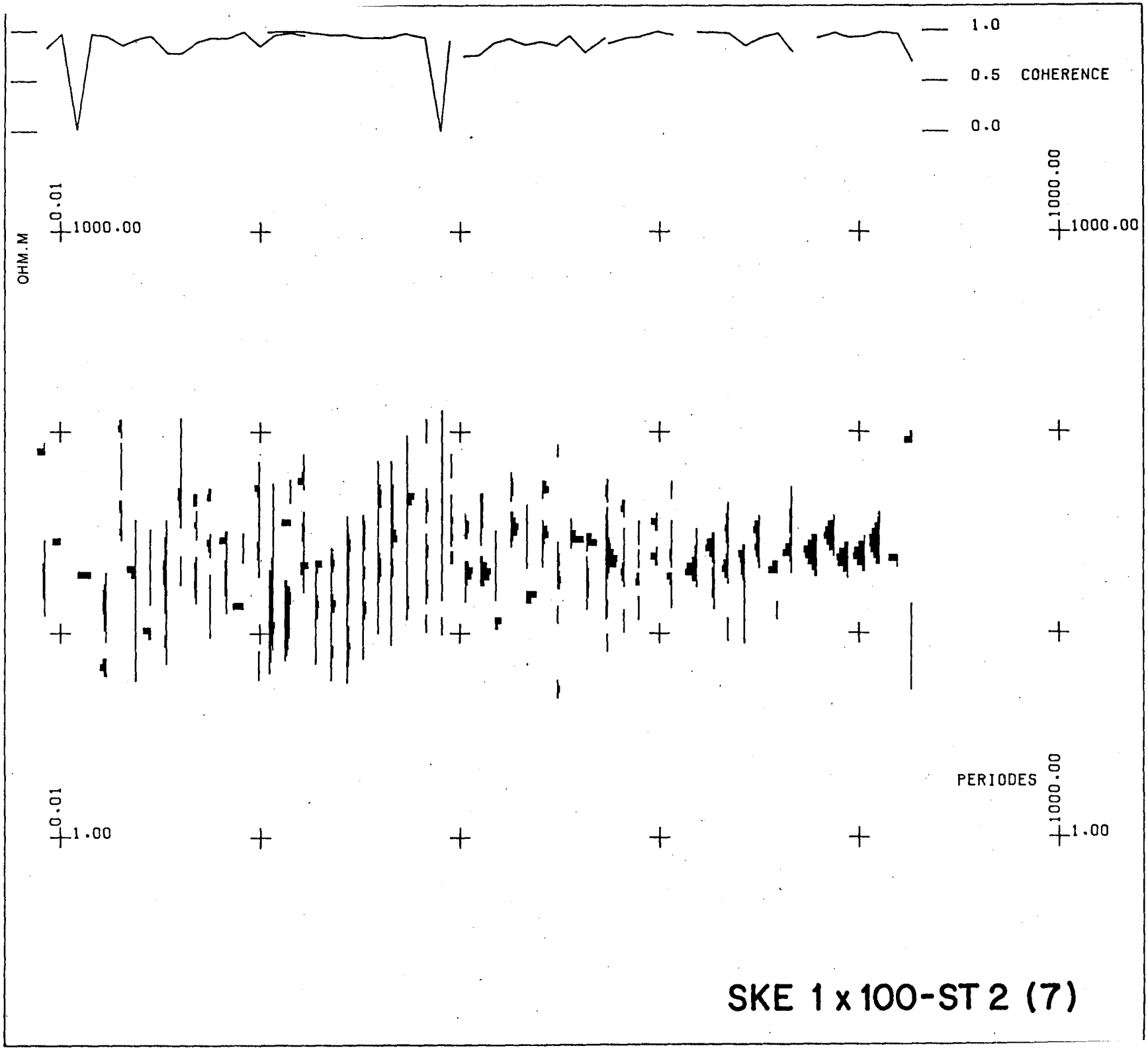

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
TIP 1 x 100 - SP 2

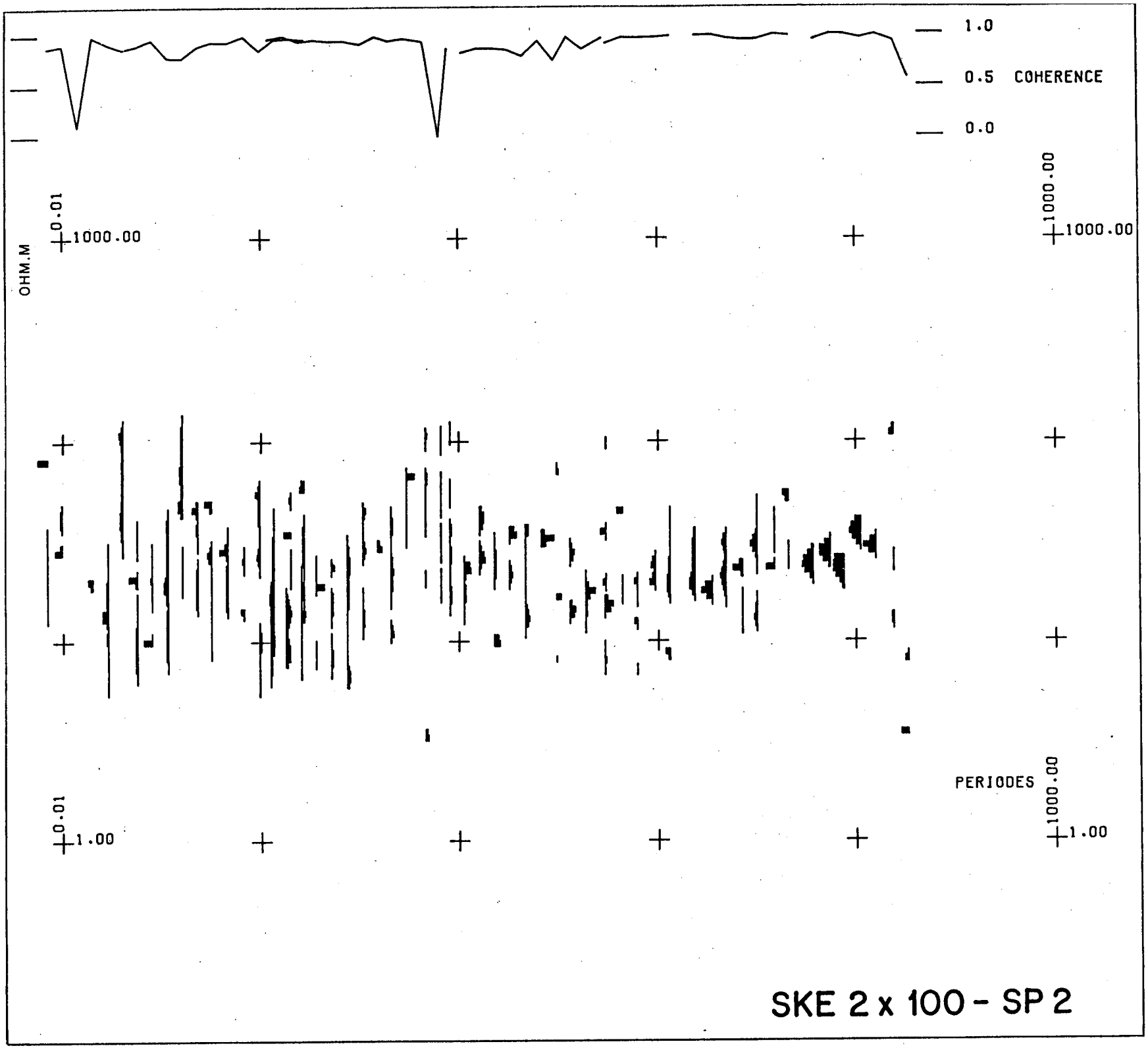

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
TIP 1 x 100-ST 2 (7)


1.0
0.5 COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
TIP 2 x 100-SP 2

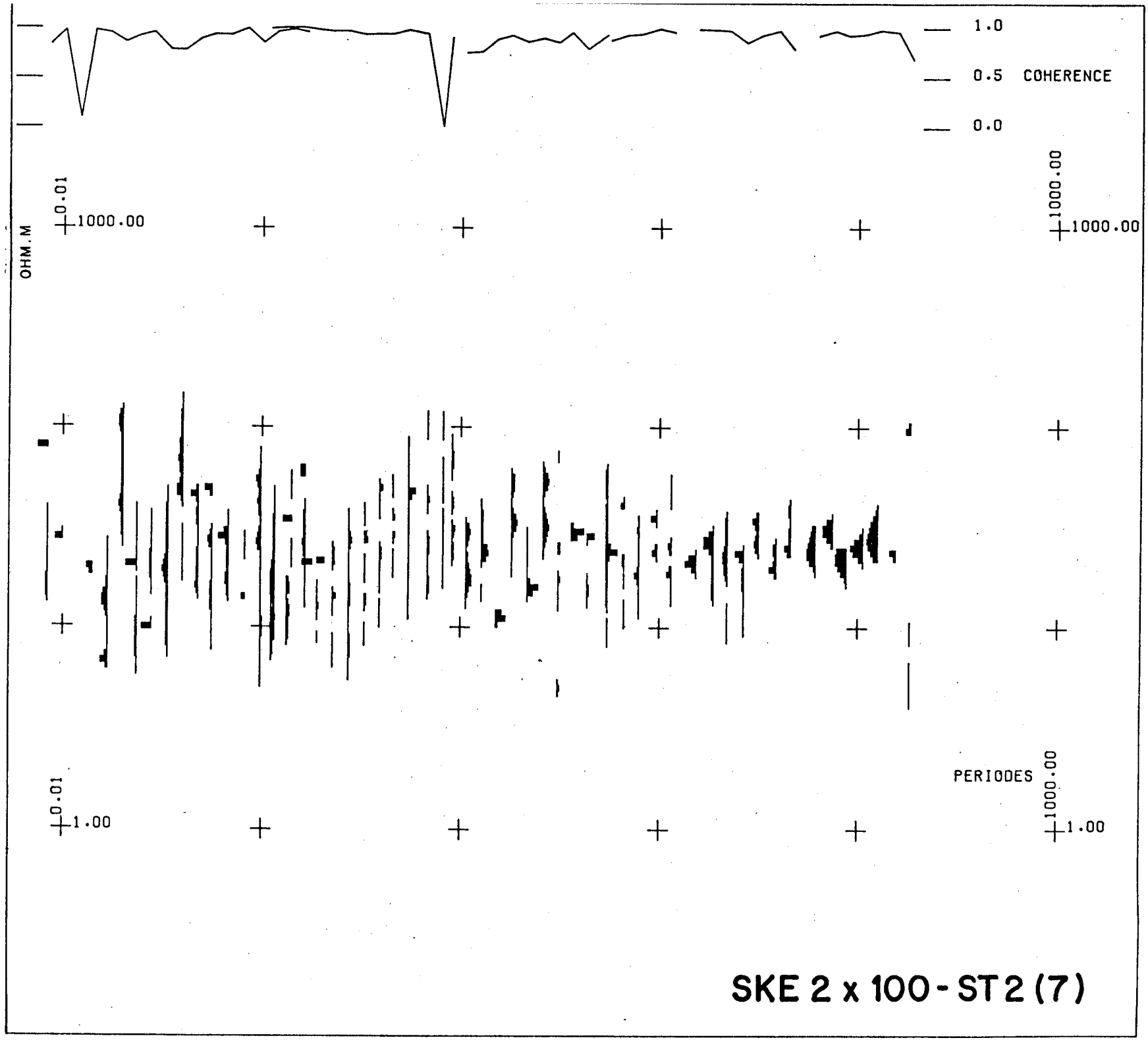

1.0
0.5 COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
TIP 2 x 100-ST 2 (7)

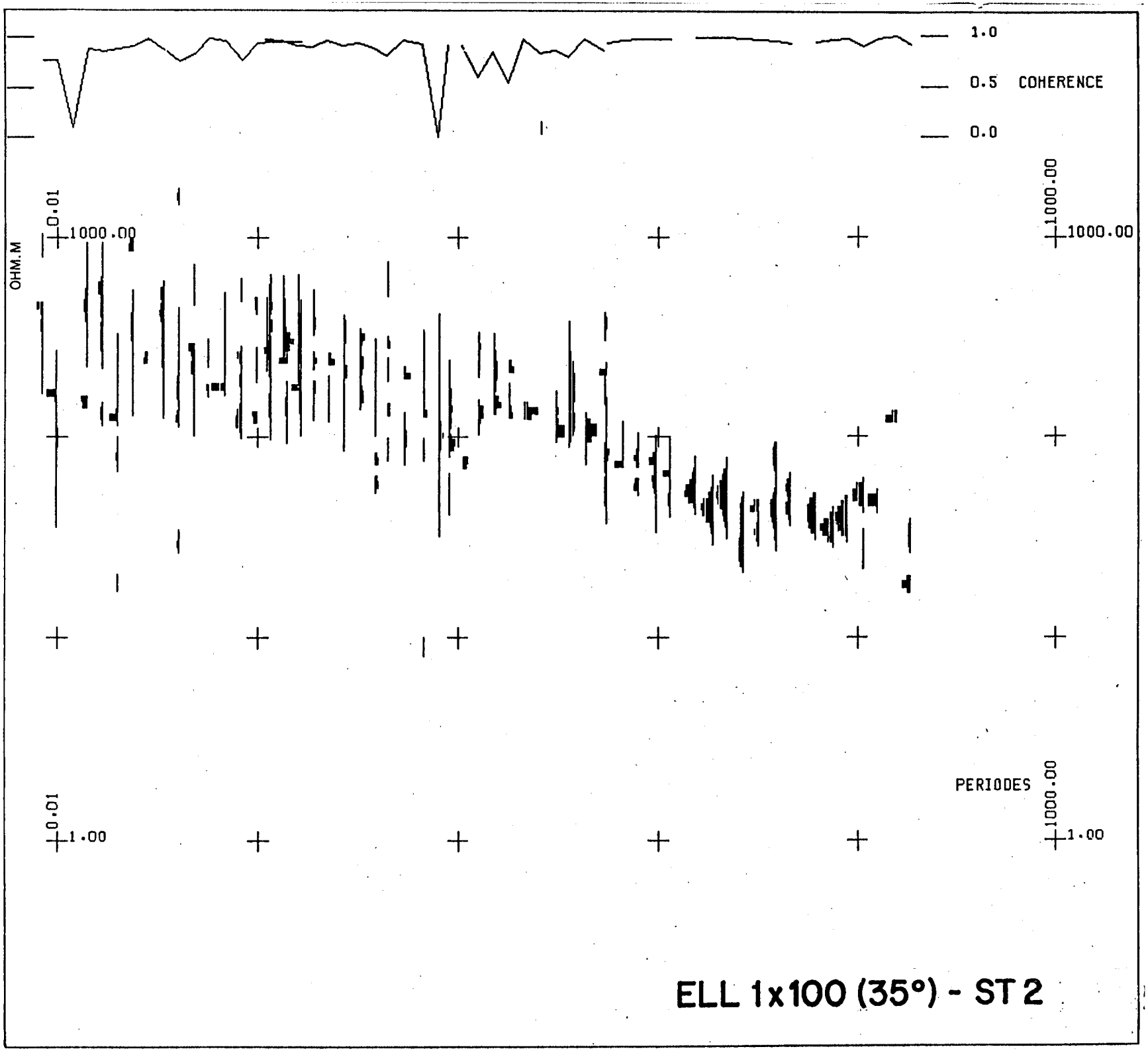

1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
SKE 1 x 100 - SP 2


1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
SKE 1 x 100-ST 2 (7)

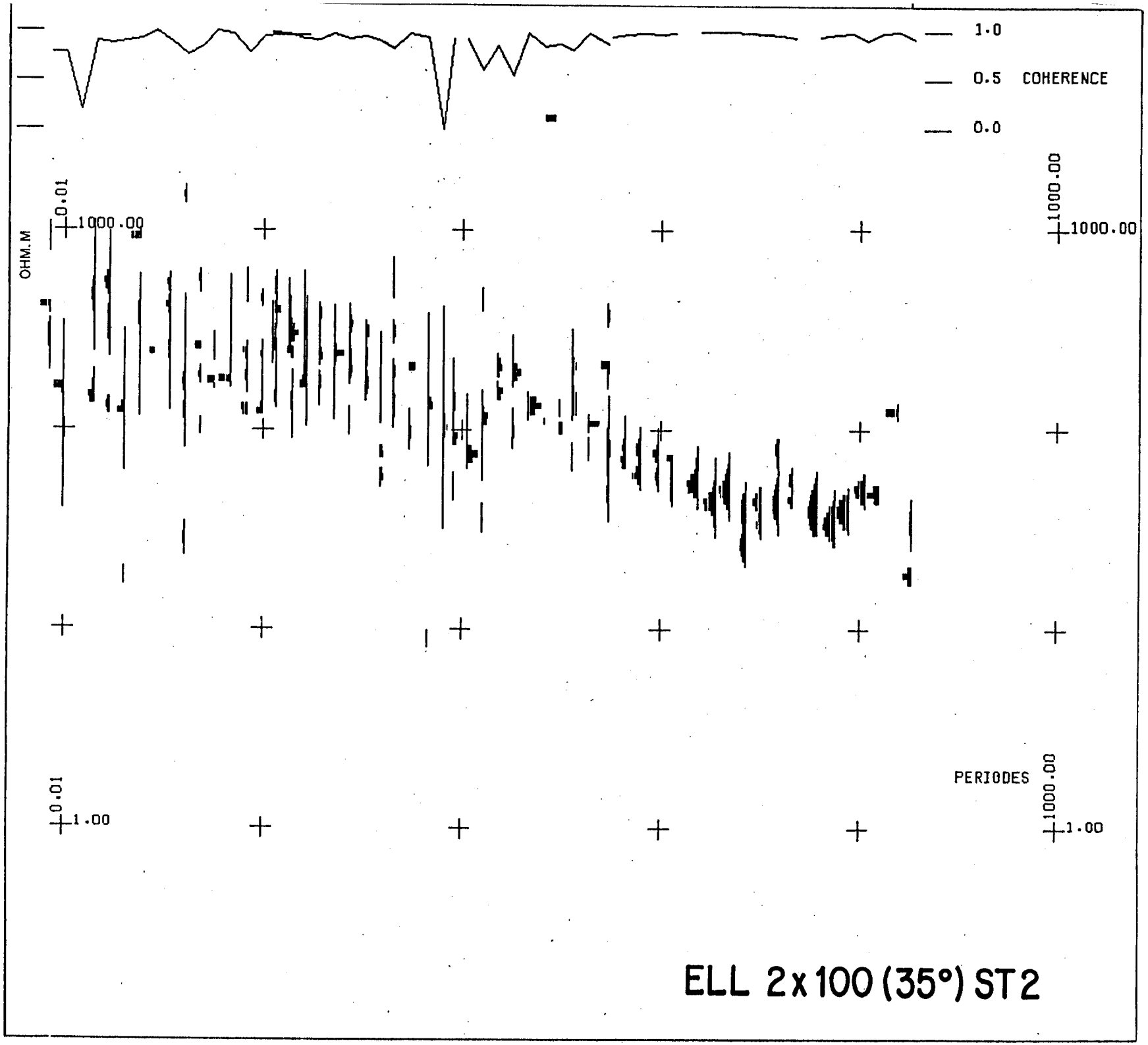



SKE 2 x 100 - SP 2


1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
SKE 2 x 100 - ST 2 (7)




ELL 1x100 (35°) - ST 2


1.0
0.5
COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00
ELL 2x100 (35°) ST2

# UNION OIL COMPANY OF CALIFORNIA

UNION GEOTHERMAL DIVISION

---

# MAGNETOTELLURIC SURVEY

GLASS MOUNTAIN PROSPECT

OCTOBER, 1982

---

# ANNEX 1: RESULTS OF PROCESSING

UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 1

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/25 | 71 | | 70 | | 72-73 | |
| 10/26 | 75 | C | 74 | C | 76 | C |
| 10/27 | 78 | B | 77 | B | 79 | B-A |
| | 79 | A | 80 | A | | |

| FIELD ARRAY | AZ. | Cent.º | Sex. º = Azimuth |
|---|---|---|---|
| | Ex | 75 | 67.5 = 67°5E |
| | Ey | 375 | 337.5 = 22°5W |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 77°5E | 170 | 257.5 = 77.5E | XY | YX |
| STRIKE from Hz | 48°E | | | | |

## COMMENTS

### FIELD

10/25 Low Signal, thunderstorm

10/26 = Idem

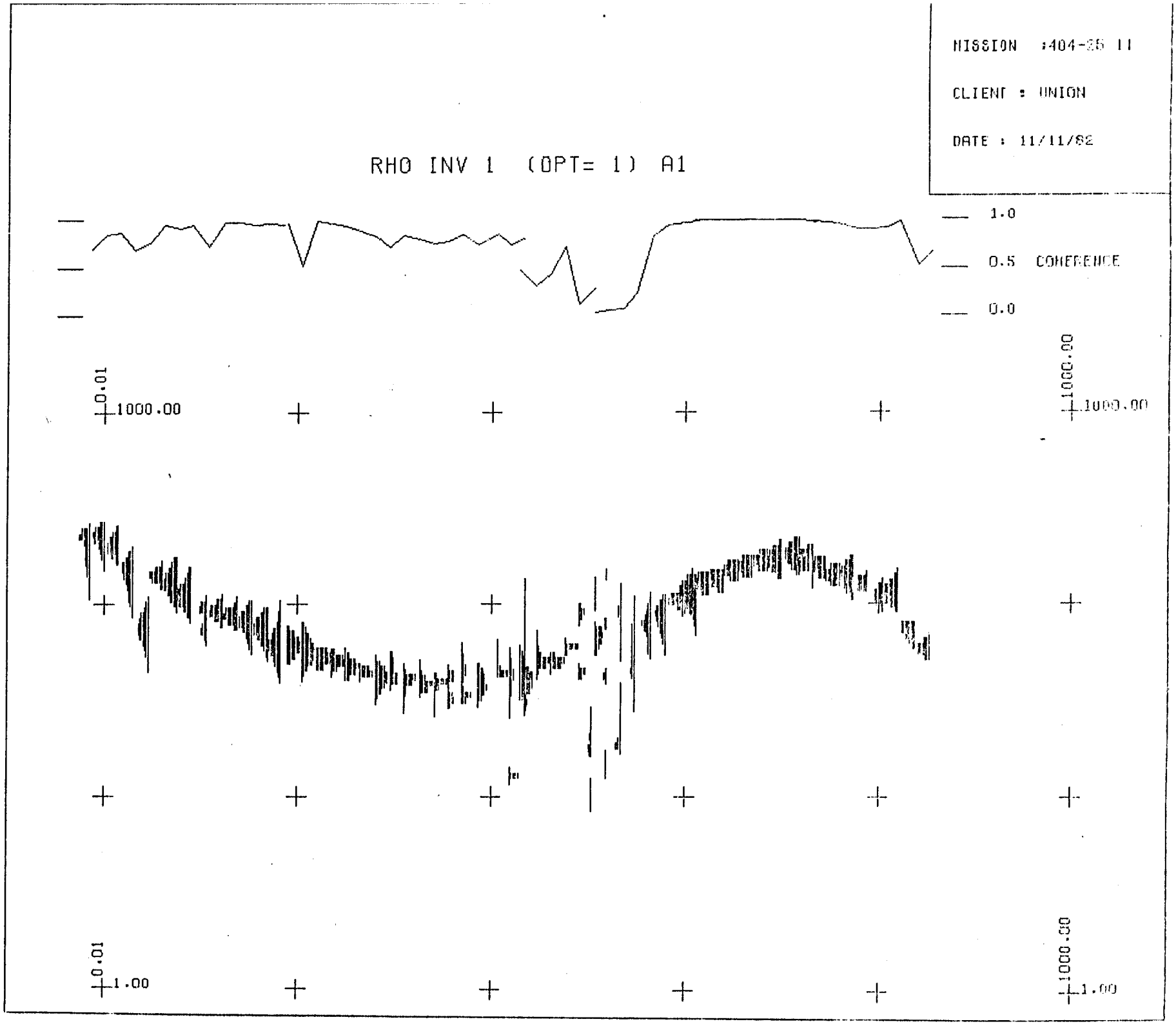
10/27 = OK - Sunny - no wind
snow on the ground
no thunderstorm

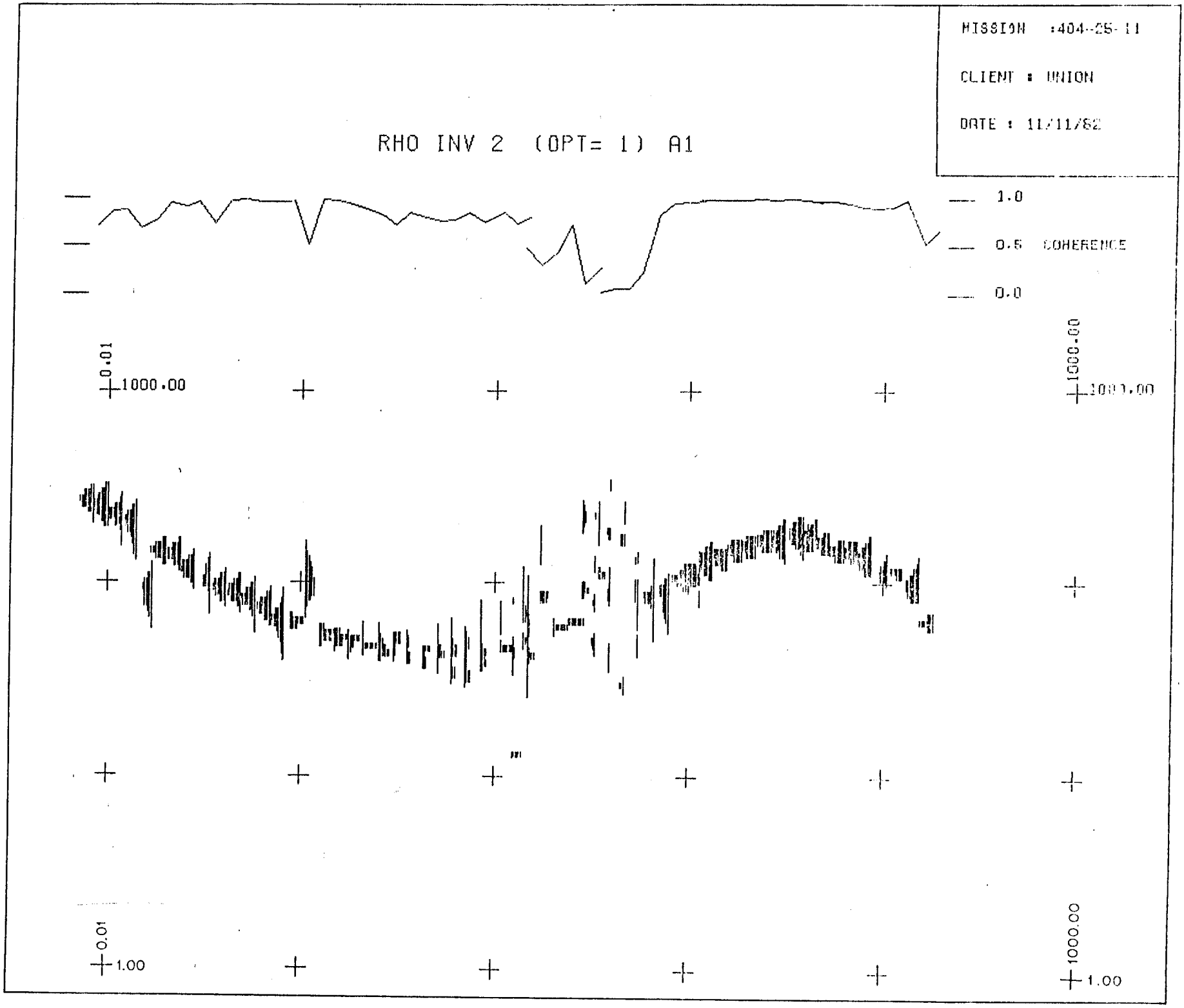
### PROCESSING

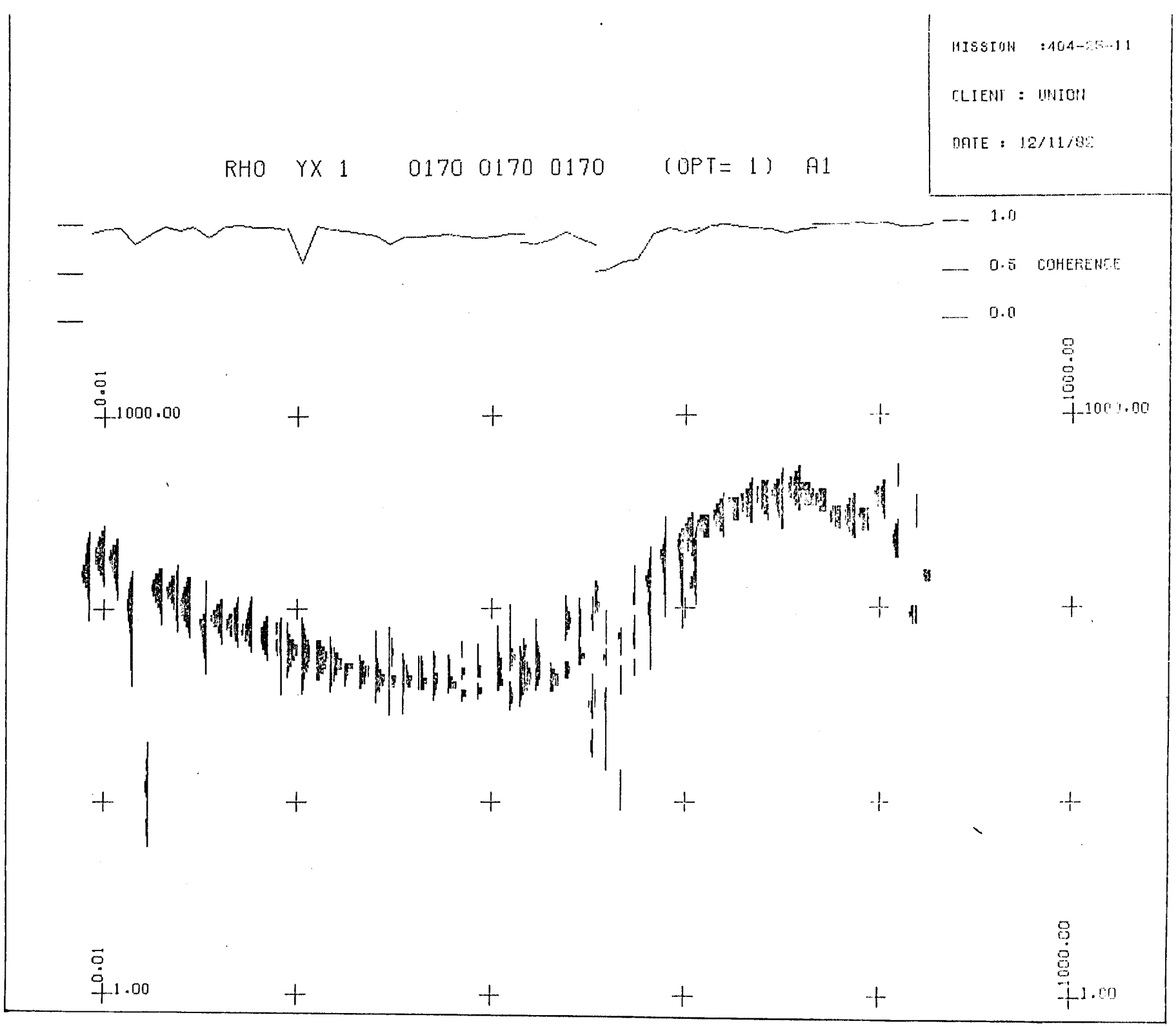
Fair

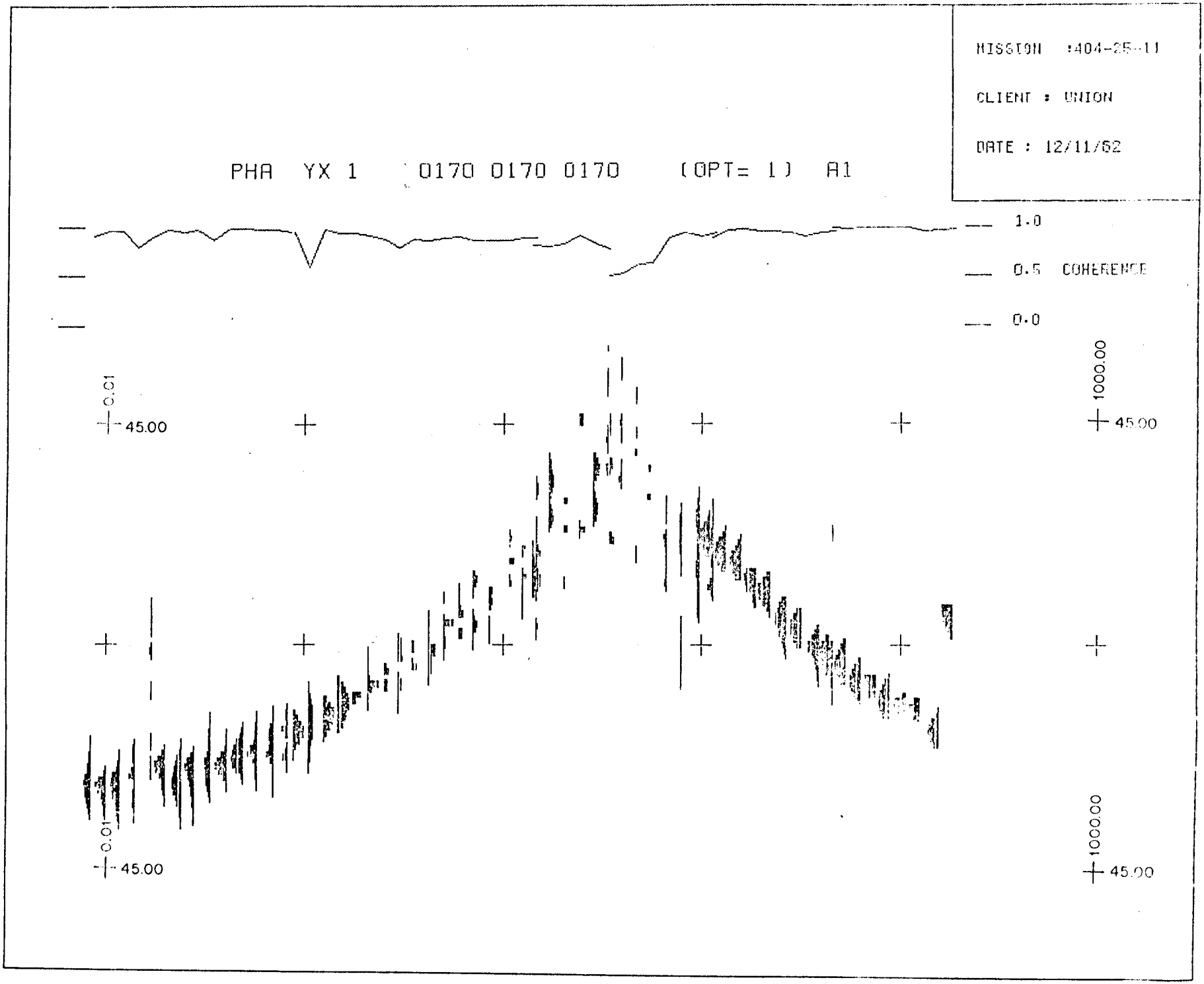
HF: $\rho E \# \rho H$

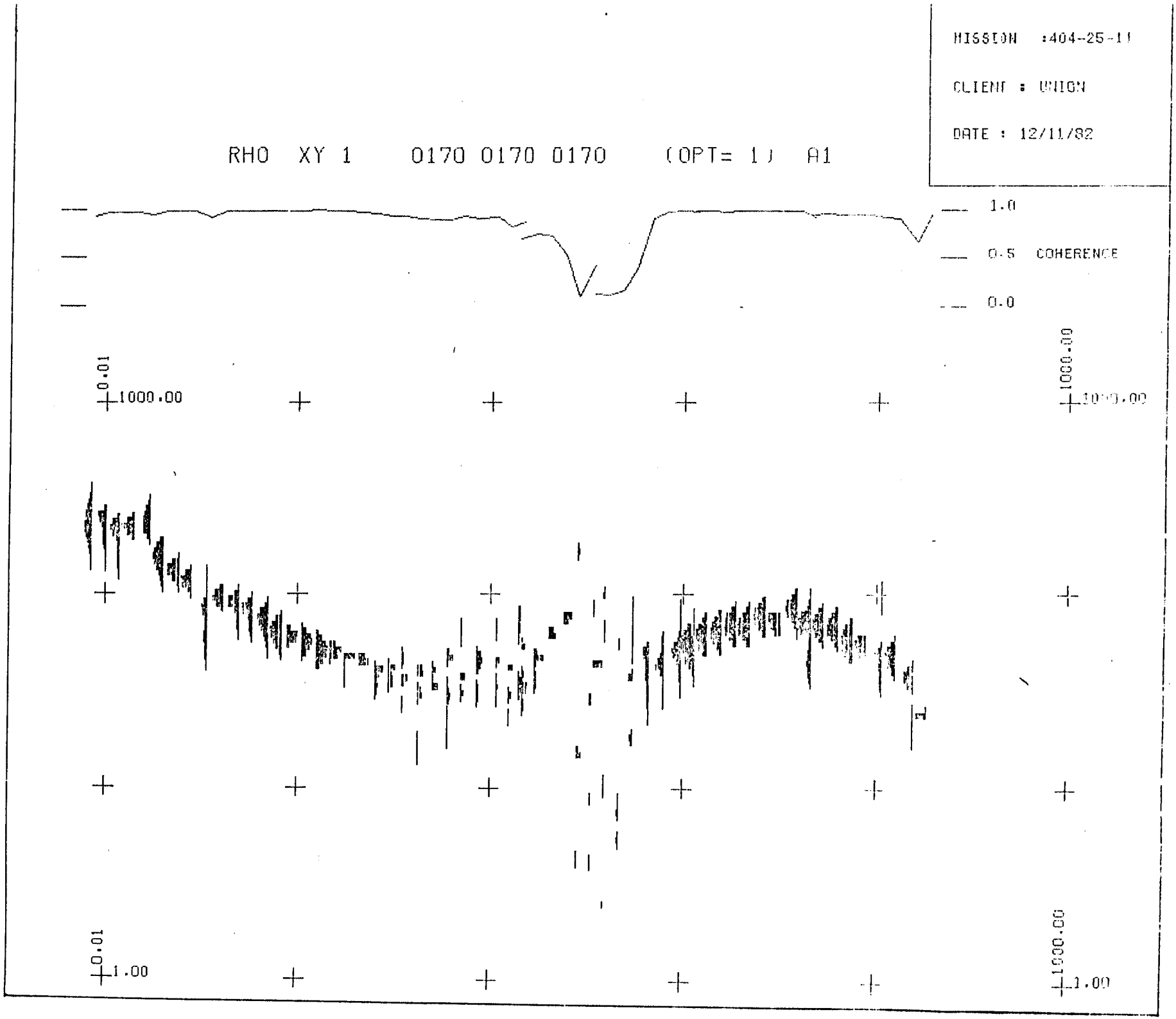
LF: $\rho E < \rho H$

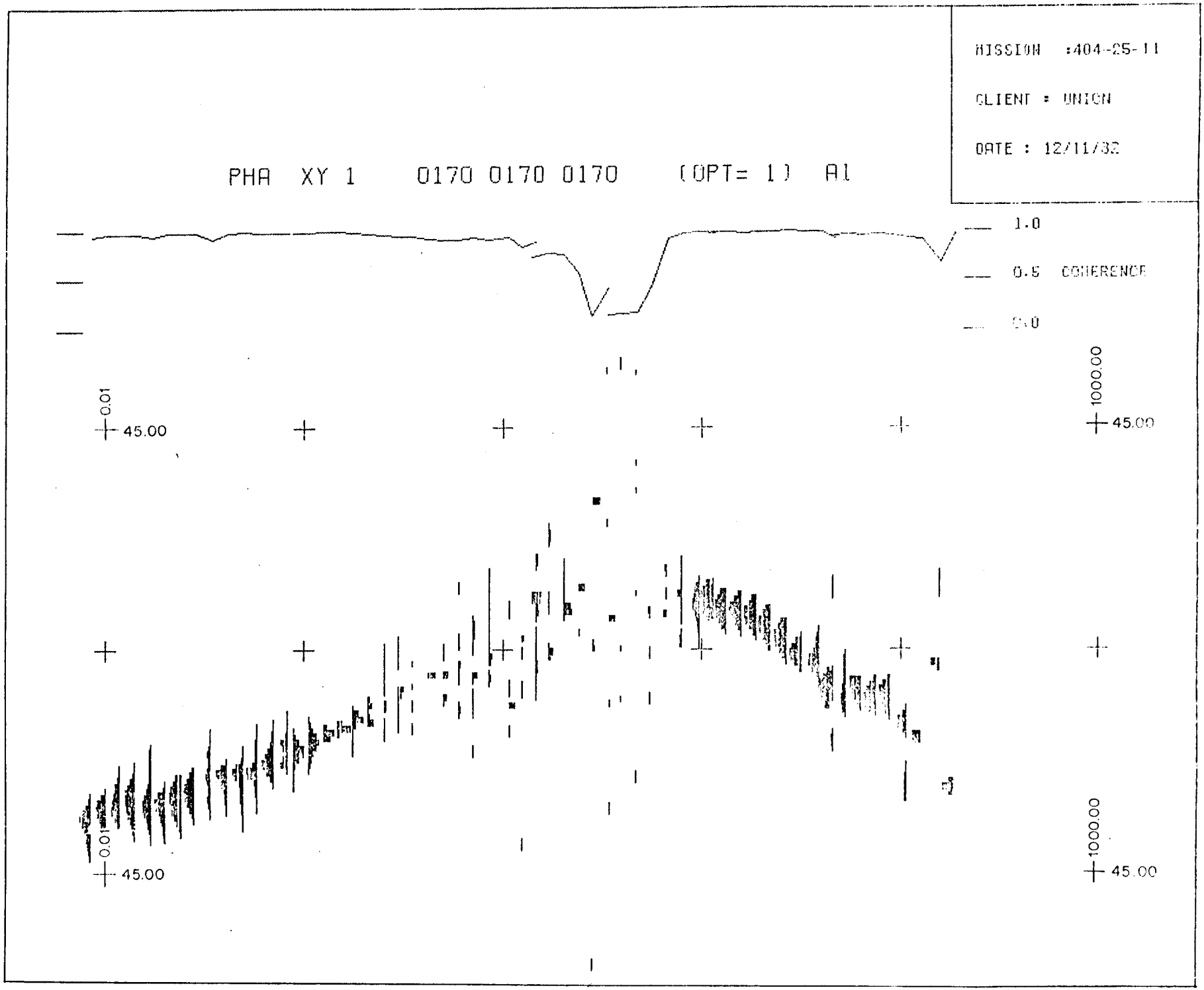

MISSION :404-35 11
CLIENT : UNION
DATE : 11/11/82
RHO INV 1 (OPT= 1) A1
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

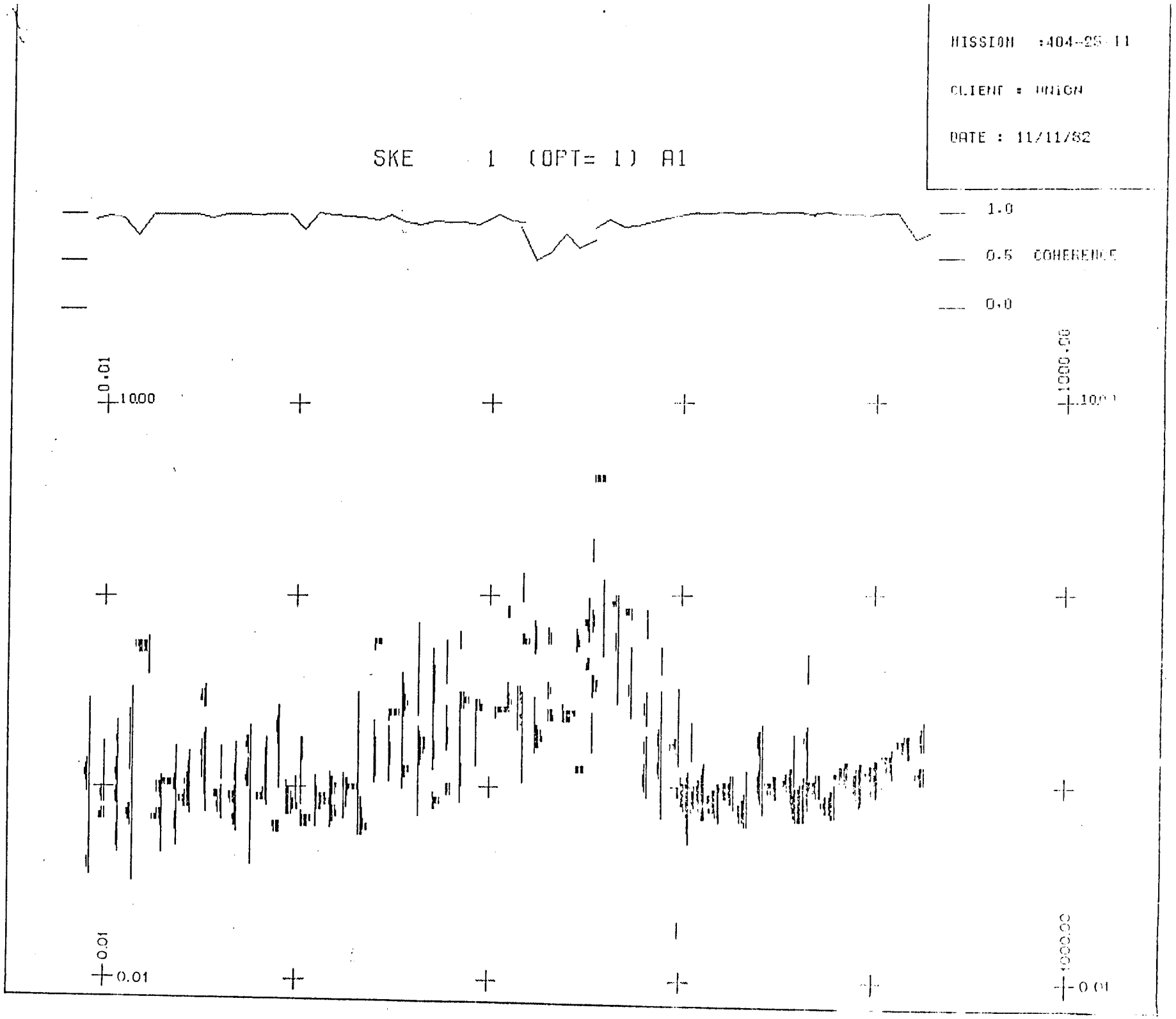

MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/82
RHO INV 2 (OPT= 1) A1
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1.00
0.01
1.00
1000.00

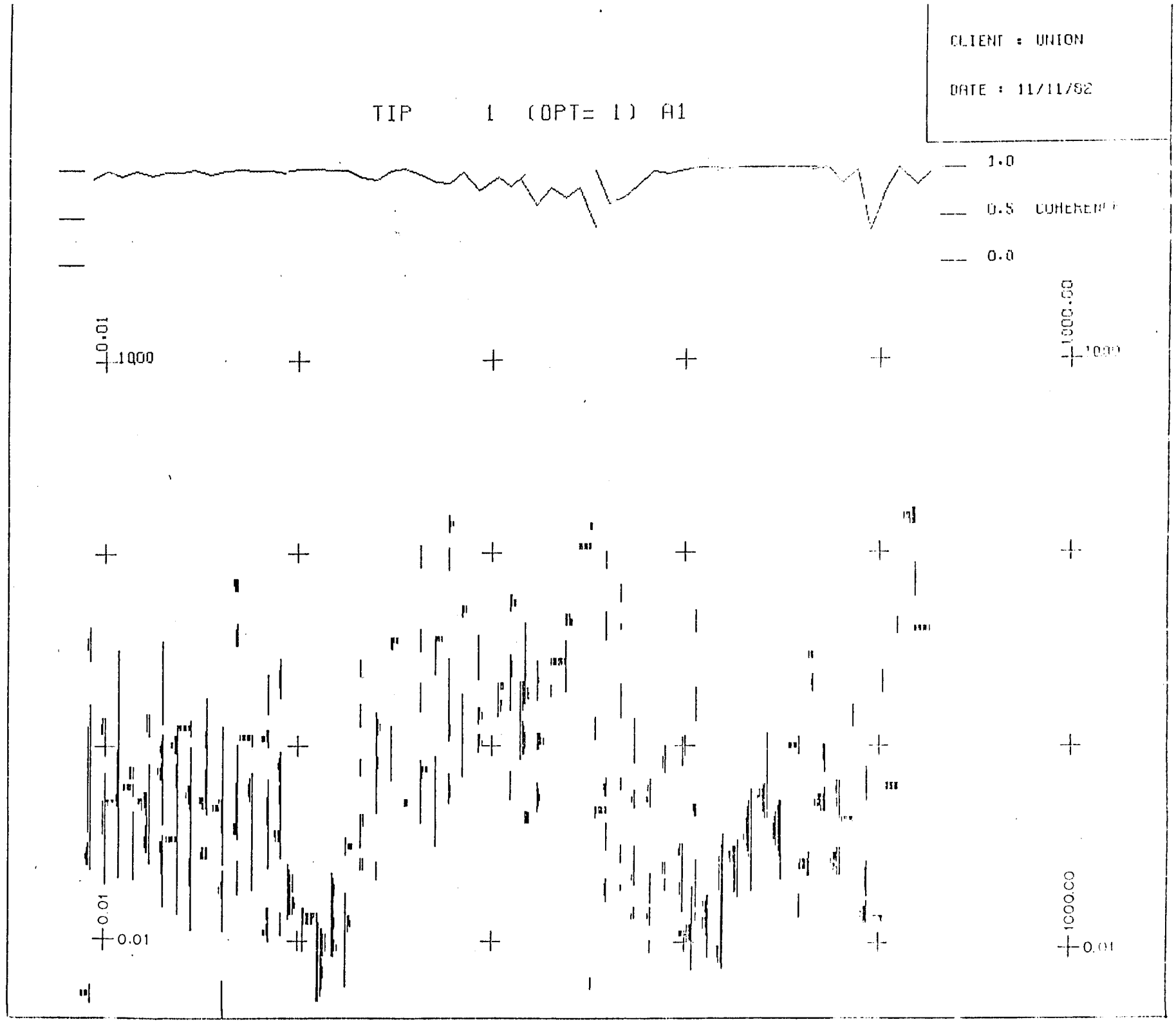

MISSION :404-[illegible]-11
CLIENT : UNION
DATE : 12/11/82
RHO YX 1 0170 0170 0170 (OPT= 1) A1
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
PHA YX 1 0170 0170 0170 (OPT= 1) A1
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
RHO XY 1 0170 0170 0170 (OPT= 1) A1
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT = UNION
DATE : 12/11/32
PHA XY 1 0170 0170 0170 (OPT= 1) A1
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25 11
CLIENT : UNION
DATE : 11/11/82
SKE 1 (OPT= 1) A1
1.0
0.5 COHERENCE
0.0
0.01
1000.00
0.01
0.01
1000.00
0.01

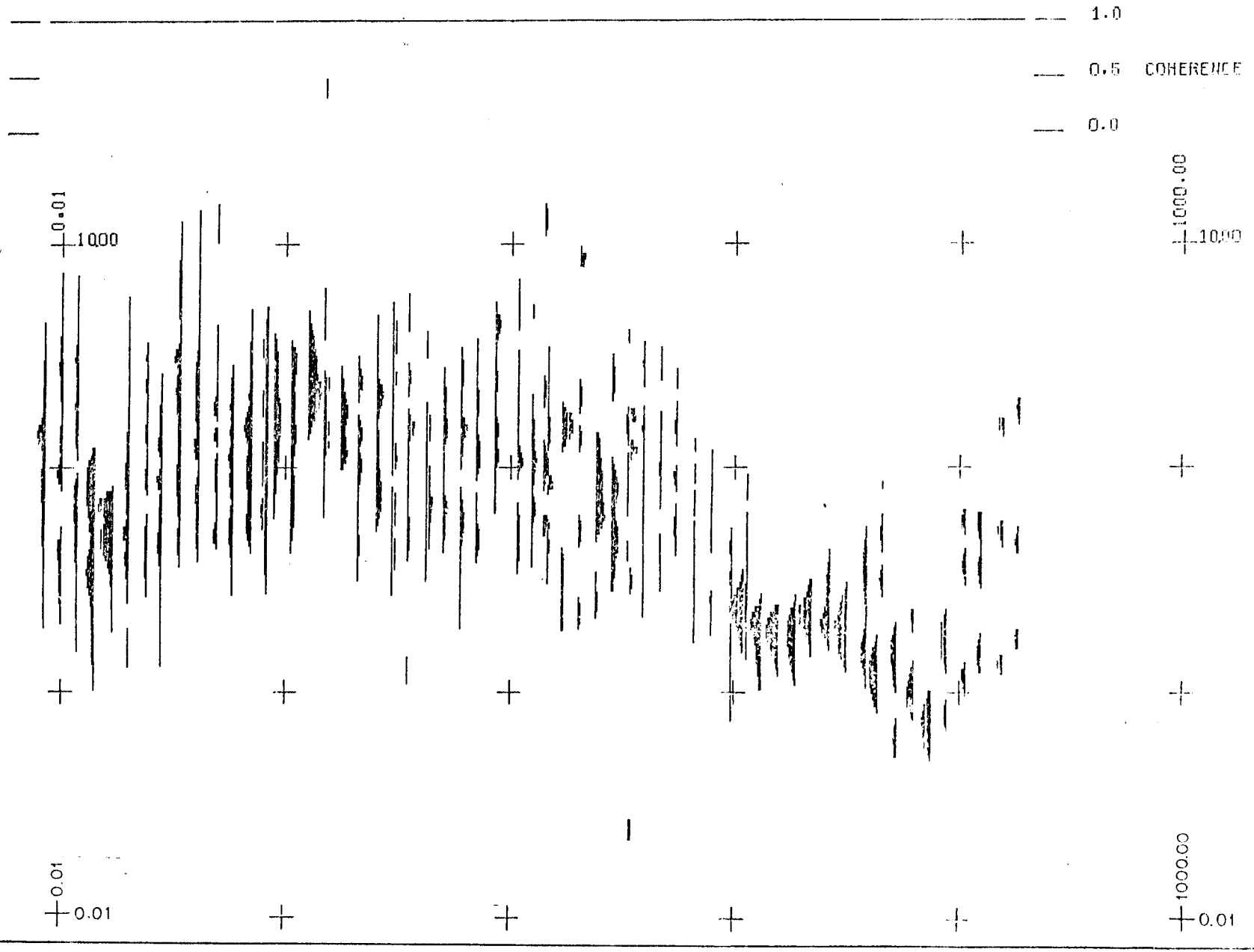

CLIENT : UNION
DATE : 11/11/82
TIP 1 (OPT= 1) A1
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
1000
0.01
0.01
1000.00
0.01

MISSION :404-25-11

CLIENT : UNION

DATE : 12/11/82

ELL 1 0170 0170 0170 (OPT= 1) A1

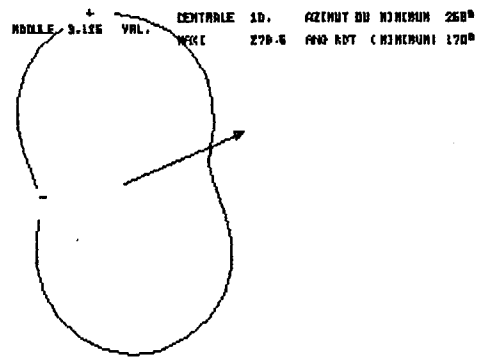


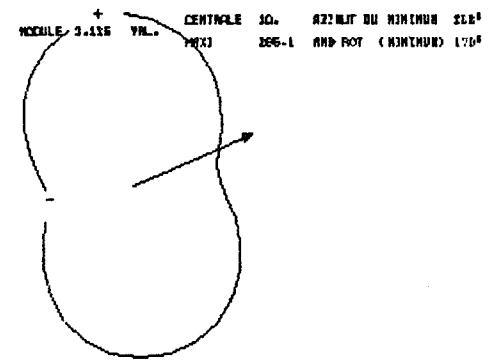
DOMAINE OF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 75cm
SKEW = 0.100
TIPPER = 0.170
COMBINAISON 1

SKEW = 0.102
TIPPER = 0.178
COMBINAISON 2

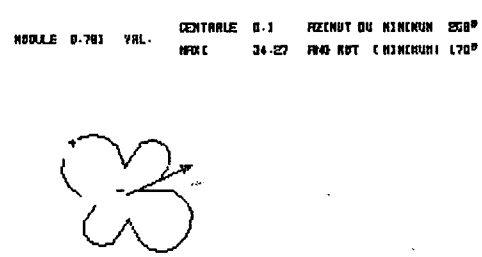
MISSION : =404-25-11
CLIENT : UNION
DATE : 11/11/82

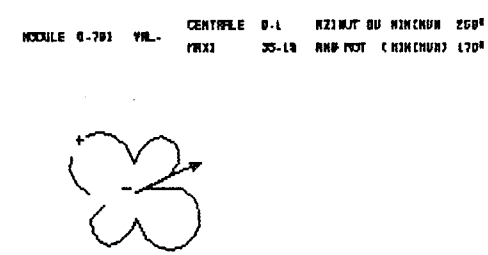
XY



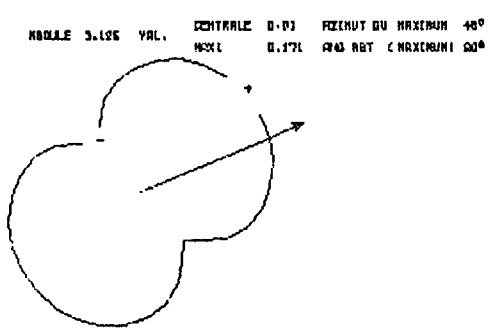



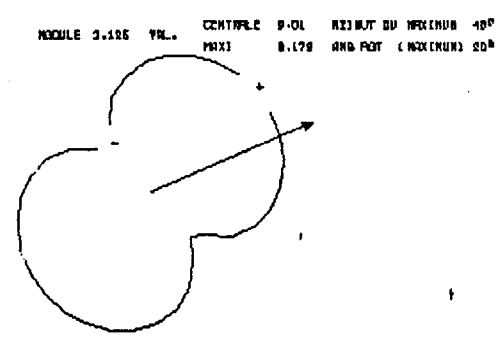

XX




YZ



STATION A1
DOMAINE MF
DECOUPAGE EN , 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 75mm
SKEW = 0.094
TIPPER = 0.085
COMBINAISON 1

XY

MODULE 3.126 VAL. CENTRALE LOG. AZIMUT DU MINIMUM 48°
MAXI LOG-1 AND ROT (MINIMUM) 20°

XX

MODULE 1.562 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 258°
MAXI 4.05 AND ROT (MINIMUM) 130°

YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 68°
MAXI 0.086 AND ROT (MAXIMUM) 13°

SKEW = 0.109
TIPPER = 0.088
COMBINAISON 2

XY

MODULE 3.126 VAL. CENTRALE 100. AZIMUT DU MINIMUM 48°
MAXI 247.0 AND ROT (MINIMUM) 20°

XX

MODULE 1.562 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 68°
MAXI 17.00 AND ROT (MINIMUM) 0°

YZ

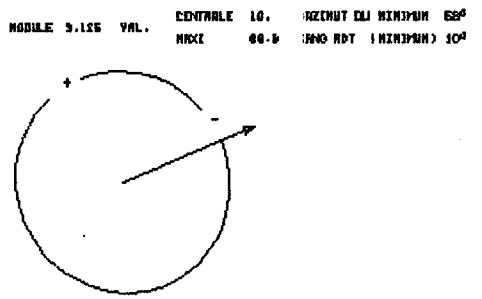
MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 68°
MAXI 0.086 AND ROT (MAXIMUM) 13°

MISSION : 484-89-11
CLIENT : UNION
DATE : 11/11/89

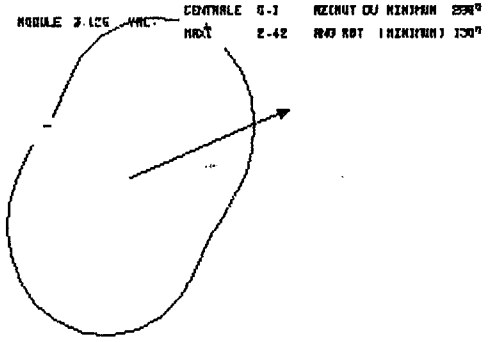
DOMAINE MF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZINUT EX 75gr
SKEW = 0.082
TIPPER = 0.112
COMBINAISON 1

MISSION : 1404-05-13
CLIENT : UNION
DATE : 31/11/82

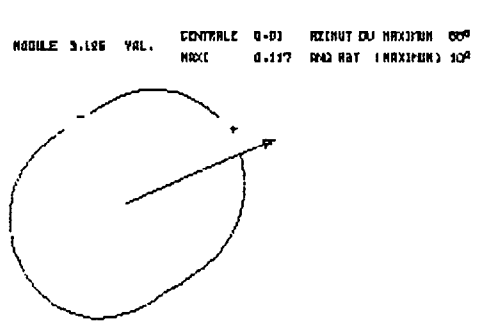
XY




XX

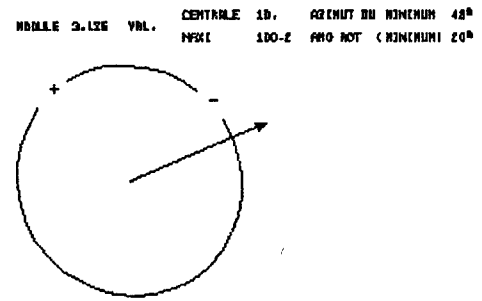



YZ

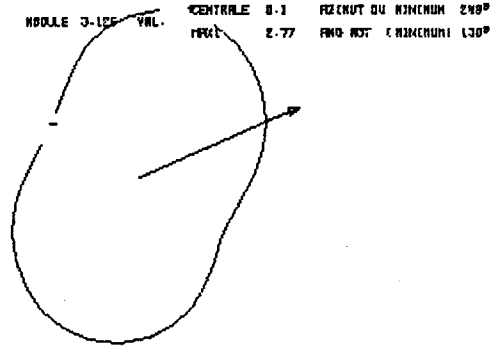



SKEW = 0.081
TIPPER = 0.116
COMBINAISON 2

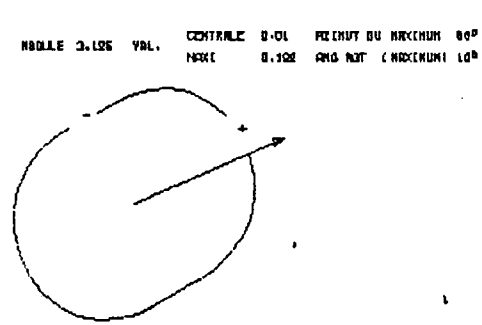
XY




XX




YZ



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 2

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/28 | 13 | A | 12 | A | 14 | A-B |
| | 16 | B | 15 | B | | |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 355 | 319.5 = 40° 5W |
| | Ey | 255 | 229.5 = 130° 5W |

| | Azimuth P | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 39°5E | 100 | 219.5 = 39.5E | XY | YX |
| STRIKE from Hz | 10°E | | | | |

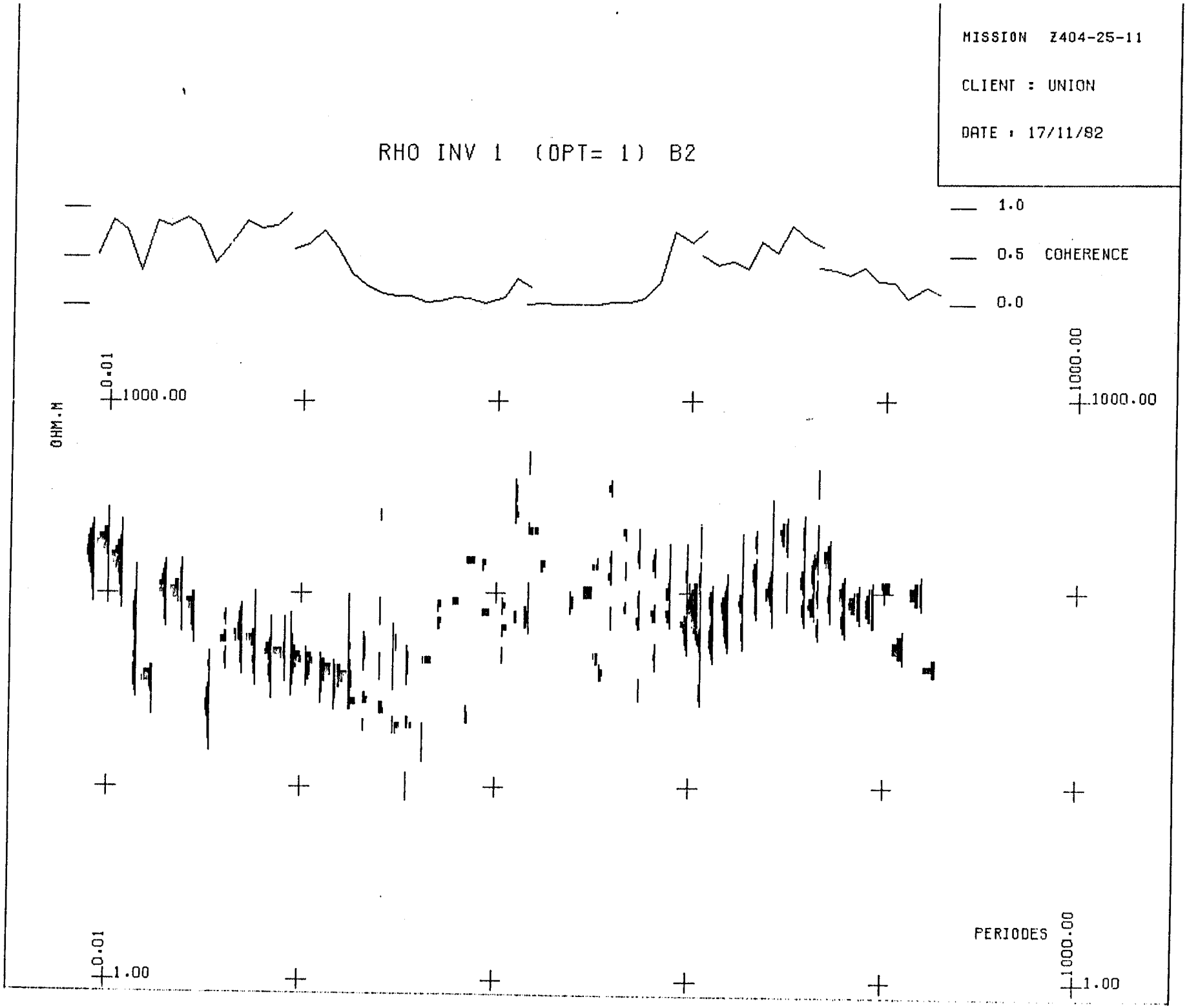
## COMMENTS

### FIELD

Rain - light snow - wind
snow cover
unconsolidated soil
proximity of lava
thunderstorms on EY

### PROCESSING

MF = very poor
LF = poor
RHOXY and $\phi$XY can hardly be used
specific reprocessing
might be worth trying
HF: $\rho E \# \rho H$
LF: $\rho E < \rho H$


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO INV 1 (OPT= 1) B2
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
0.01
1.00
PERIODES
1000.00
1.00

MISSION Z404-25-11

CLIENT : UNION

DATE : 17/11/82

RHO INV 2 (OPT= 1) B2

1.0

0.5 COHERENCE

0.0

0.01

10000.00

1000.00

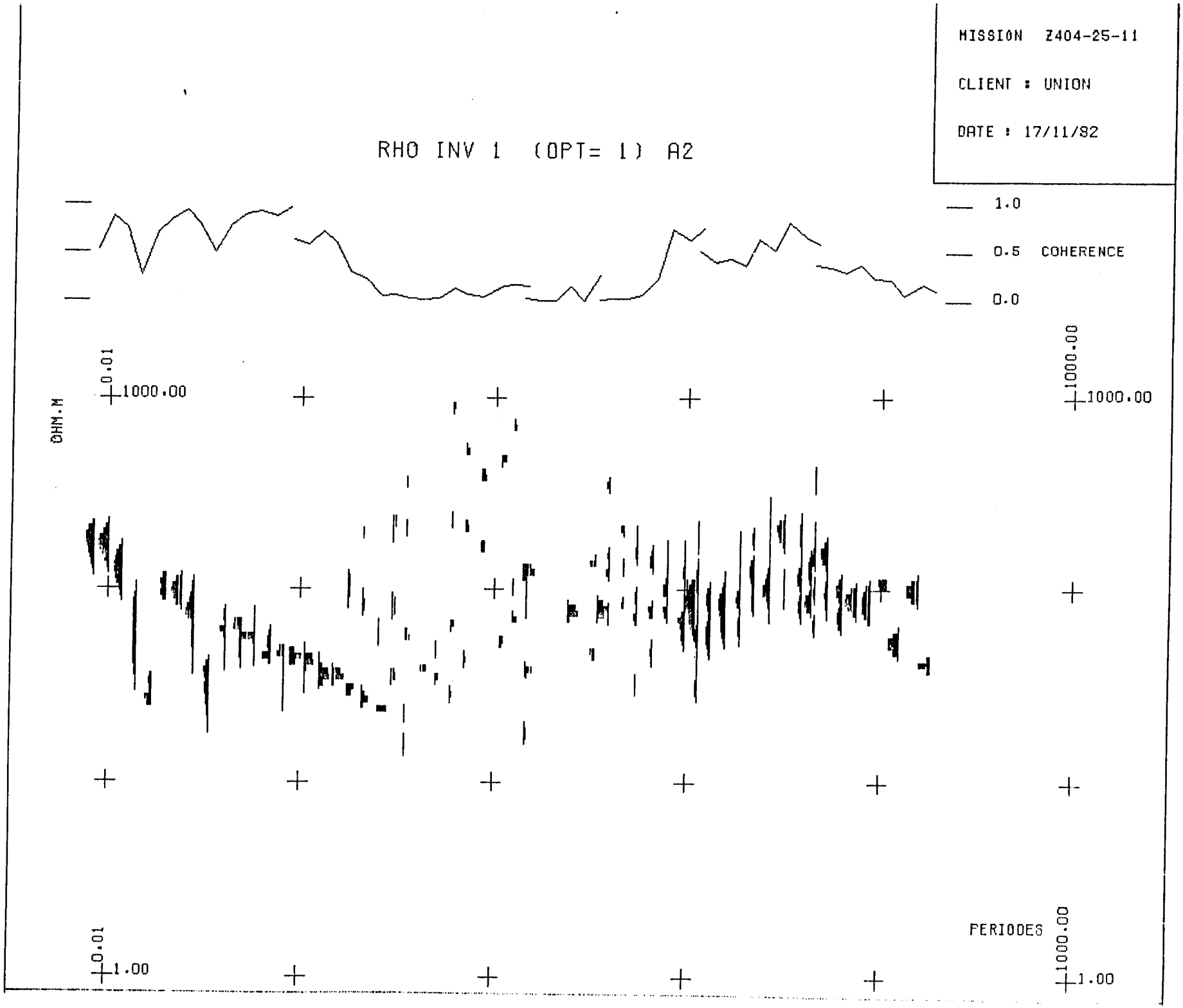
10000.00

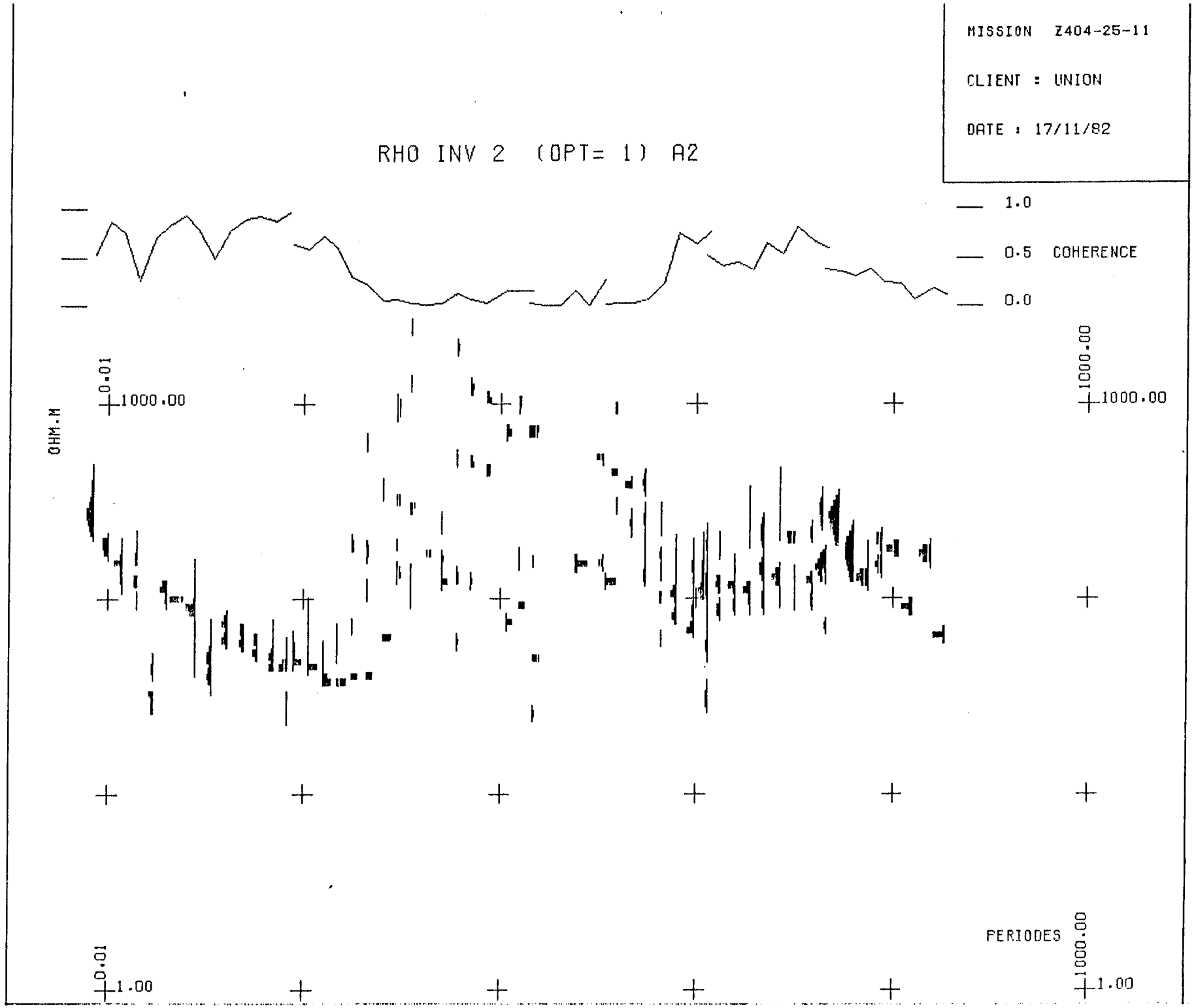
0.01

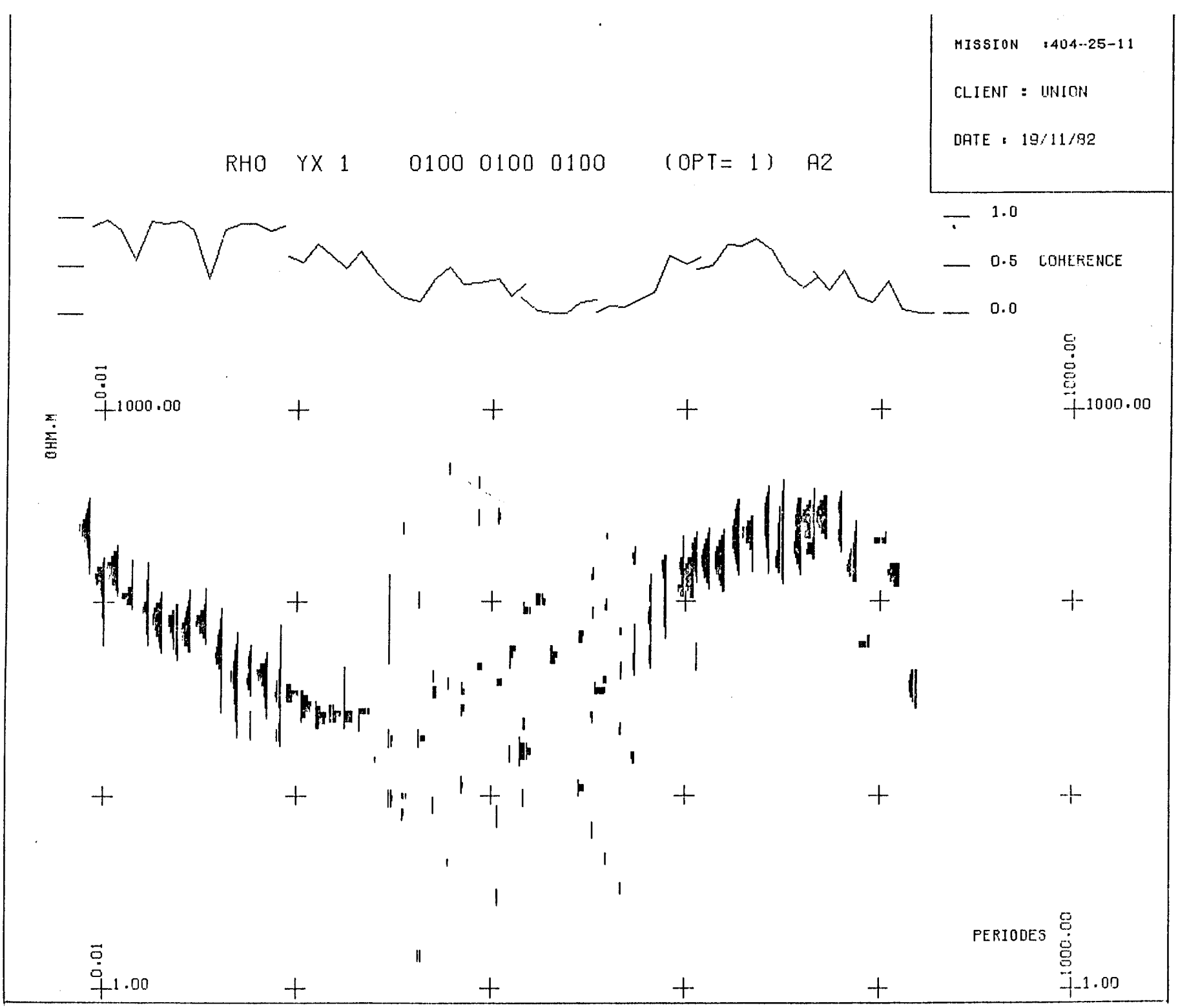
1.00

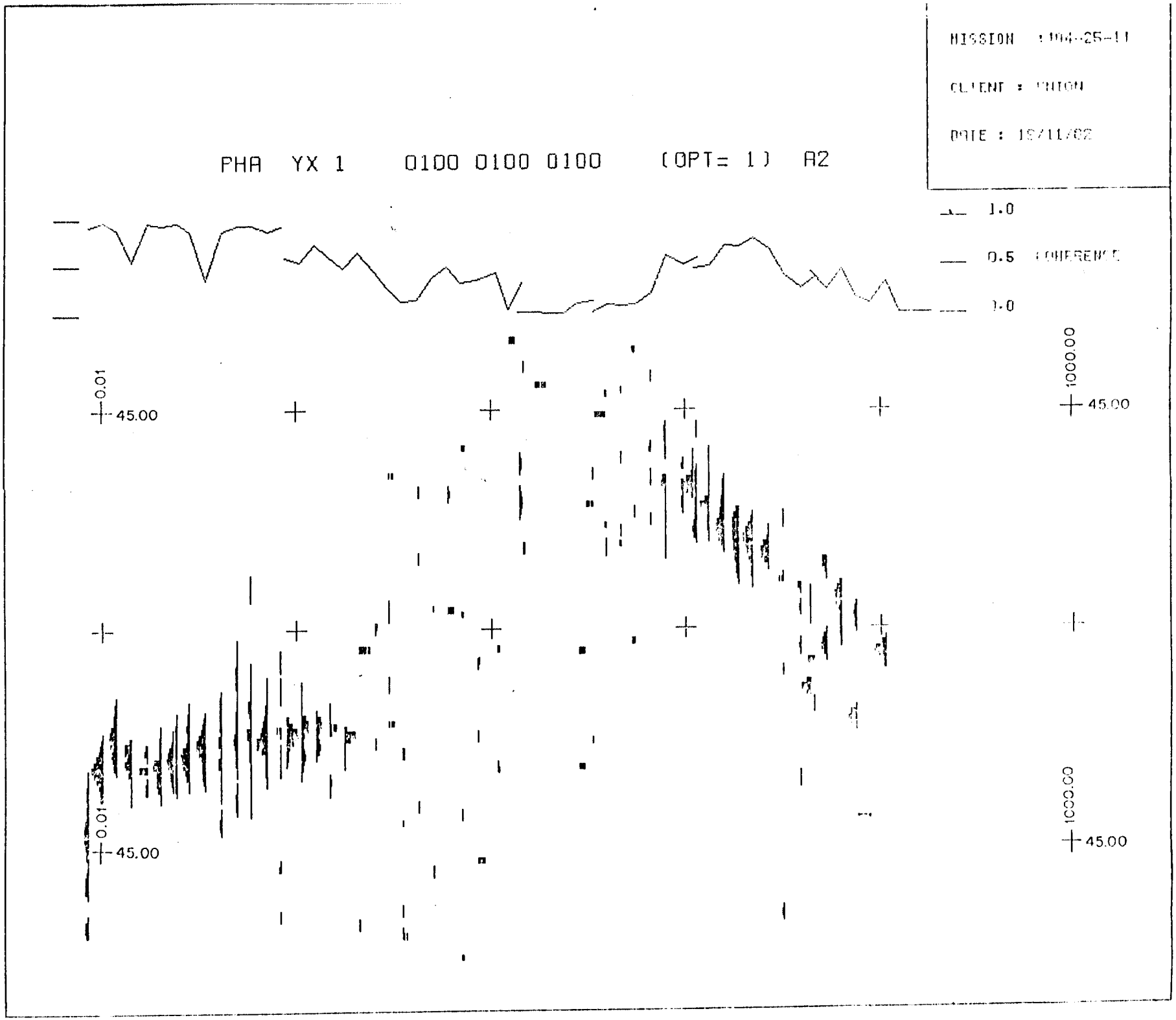
1000.00

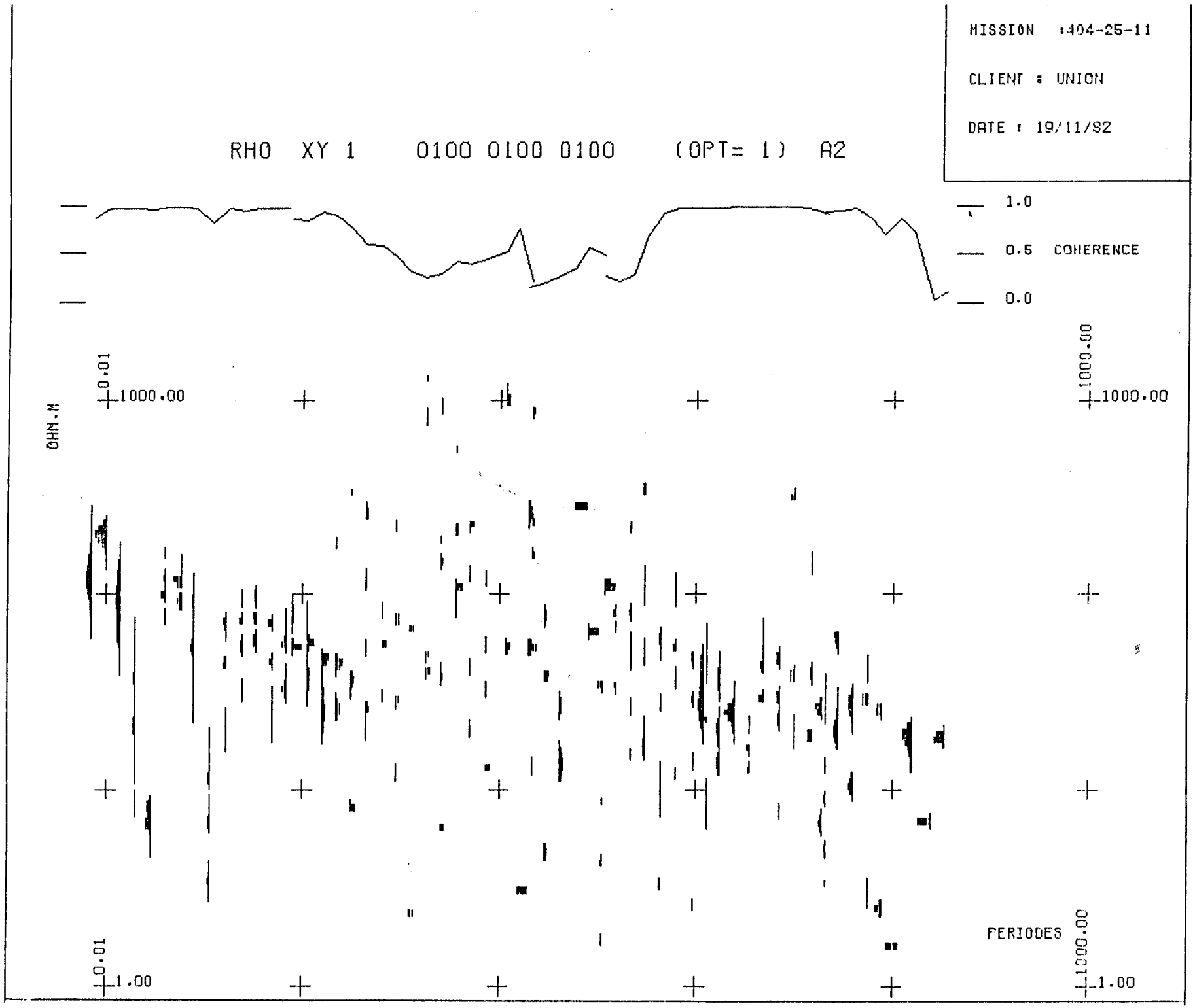
0.01

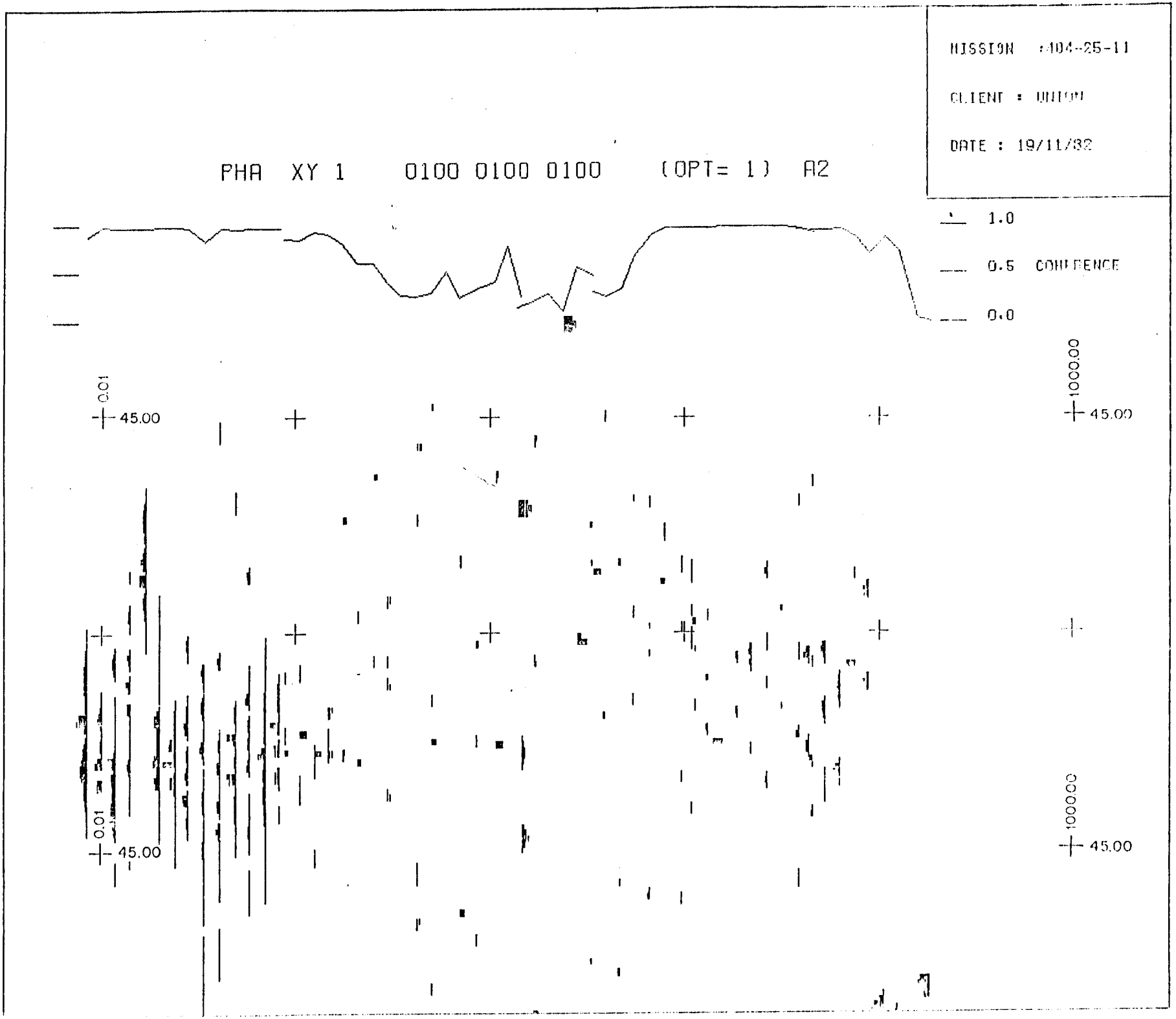

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO INV 1 (OPT= 1) A2
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
0.01
1.00
PERIODES
1000.00
1.00

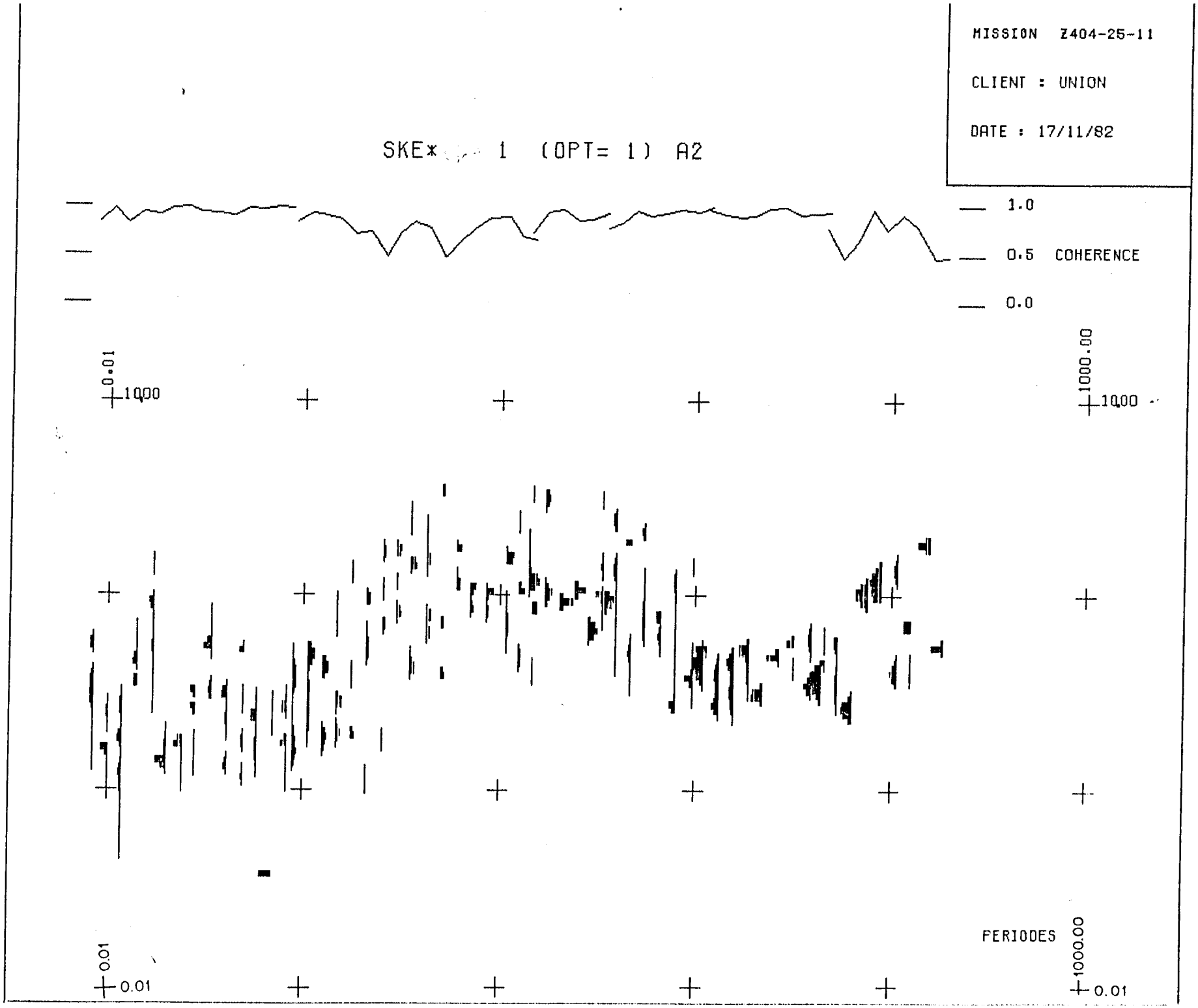

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO INV 2 (OPT= 1) A2
1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00

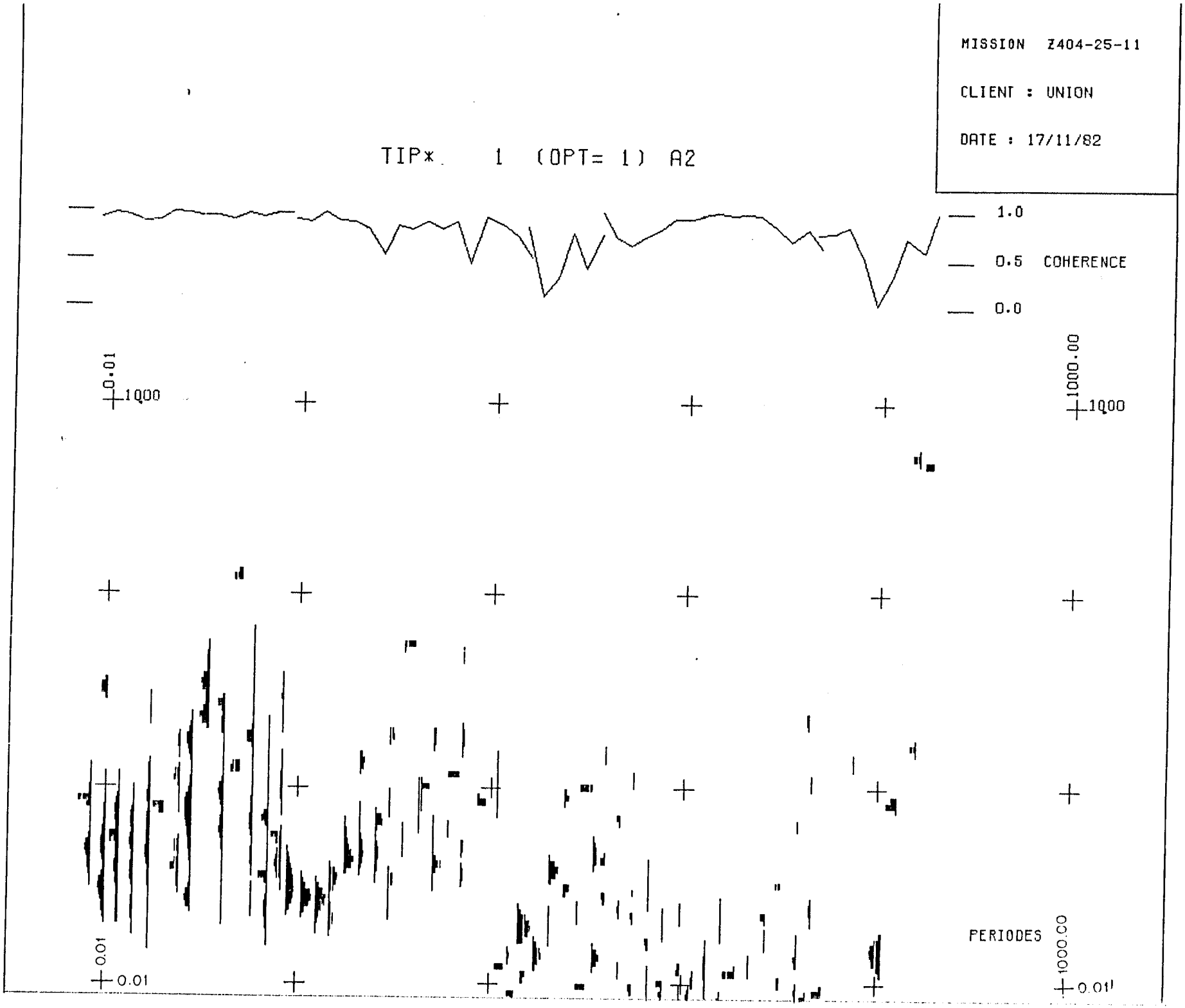

MISSION :404--25-11
CLIENT : UNION
DATE : 19/11/82
RHO YX 1 0100 0100 0100 (OPT= 1) A2
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
PERIODES
0.01
1.00
1000.00
1.00


MISSION : 004-25-11
CLIENT : UNION
DATE : 19/11/82
PHA YX 1 0100 0100 0100 (OPT= 1) A2
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 19/11/82
RHO XY 1 0100 0100 0100 (OPT= 1) A2
1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
0.01
1.00
PERIODES
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 19/11/82
PHA XY 1 0100 0100 0100 (OPT= 1) A2
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
SKE* 1 (OPT= 1) A2
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000
1000
PERIODES
0.01
1000.00
0.01
0.01

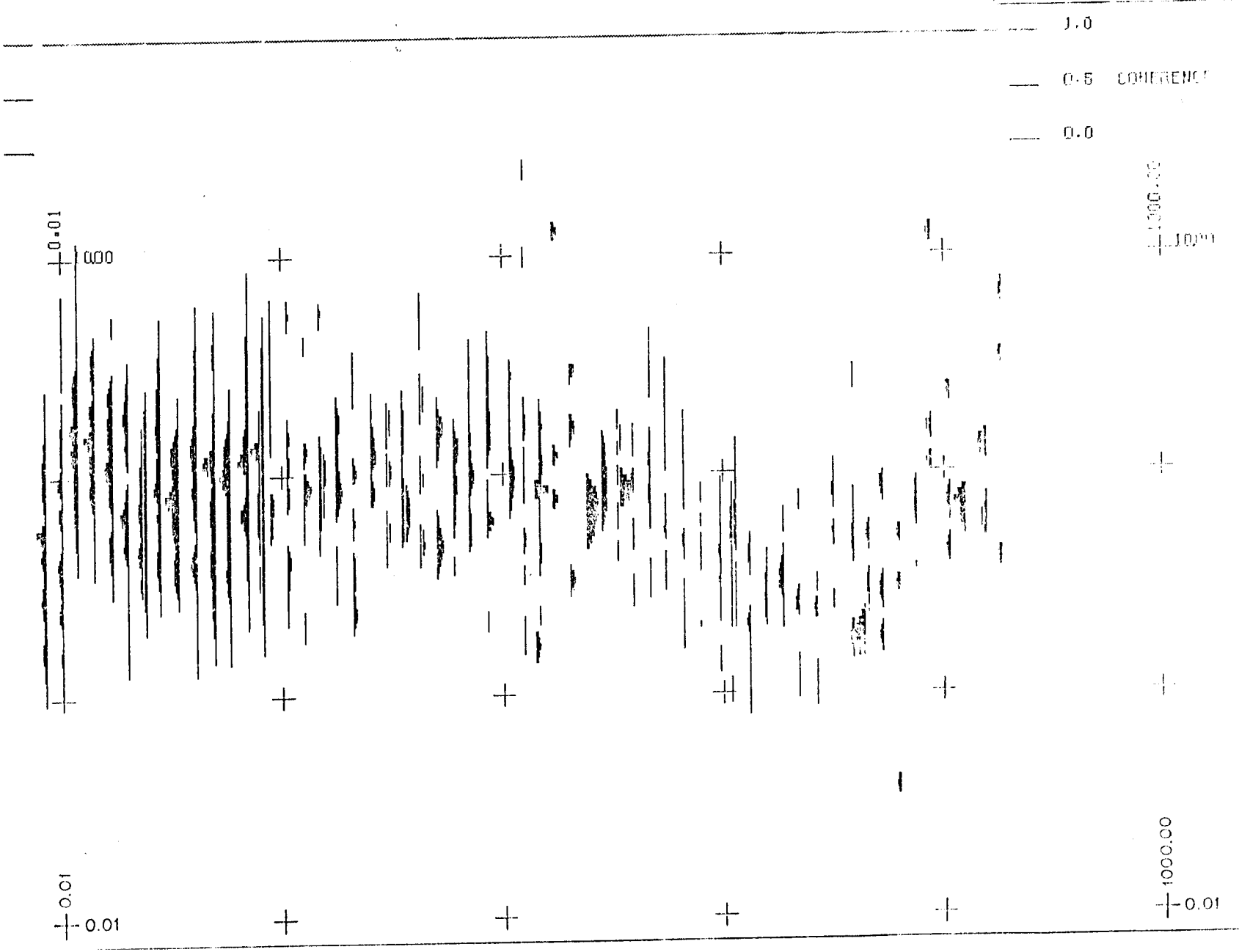

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
TIP* 1 (OPT= 1) A2
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000
1000
PERIODES
0.01
1000.00
0.01

MISSION :404-05-11

CLIENT : UNION

DATE : 19/11/92

ELL 1 0100 0100 0100 (OPT= 1) A2

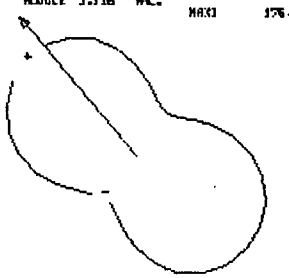


MISSION : 2404-25-11
CLIENT : UNION
DATE : 17/11/82

STATION A2
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 355DG
SKEW = 0.317
TIPPER = 0.077
COMBINAISON 1

XY

MODULE 3.135 VAL. CENTRALE 10. AZIMUT DU MINIMUM 110°
MAXI 176.2 AMP MOY (MINIMUM) 100°



XX

MODULE 1.502 VAL. CENTRALE 1. AZIMUT DU MINIMUM 100°
MAXI 57.2 AMP MOY (MINIMUM) 120°

YZ

MODULE 3.135 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 100°
MAXI 0.000 AMP MOY (MAXIMUM) 130°

SKEW = 0.295
TIPPER = 0.086
COMBINAISON 2

XY

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 352°
MAXI 228.6 AMP MOY (MINIMUM) 80°

XX

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 350°
MAXI 78.8 AMP MOY (MINIMUM) 10°

YZ

MODULE 3.135 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 100°
MAXI 0.007 AMP MOY (MAXIMUM) 130°

STATION HZ

DOMAINE HF

DECOUPAGE EN 59

TMIN = 0.04

TMAX = 0.08

AZIMUT EX 355DR

SKEW = 0.089

TIPPER = 0.183

COMBINAISON 1

MISSION : 2404-25-11
CLIENT : UNION
DATE : 17/11/82

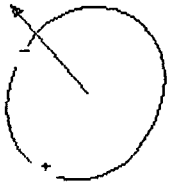
SKEW = 0.141

TIPPER = 0.165

COMBINAISON 2

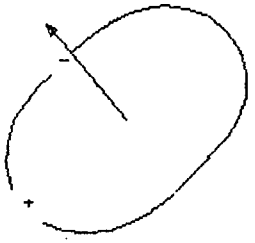
XY

MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 100°
MAXI 60.4 RAP ROT (MINIMUM) 25°



XY

MODULE 9.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 200°
MAXI 142.0 RAP ROT (MINIMUM) 10°



XX

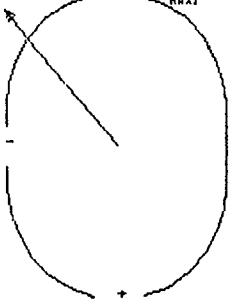
MODULE 1.052 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 280°
MAXI 5.34 RAP ROT (MINIMUM) 30°

XX

MODULE 1.052 VAL. CENTRALE 1. AZIMUT DU MINIMUM 240°
MAXI 40.8 RAP ROT (MINIMUM) 70°

YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 170°
MAXI 0.183 RAP ROT (MAXIMUM) 140°



YZ

MODULE 9.126 VAL. CENTRALE 0.1 AZIMUT DU MAXIMUM 350°
MAXI 0.18 RAP ROT (MAXIMUM) 130°

UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 3

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/23 | 66 | A | 65 | A | 67 | A-B |
| | 69 | B | 68 | B | | |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 35 | 31.5 = 31° 5E |
| | Ey | 335 | 301.5 = 58° 5W |

| STRIKE | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| from Exy, Hxy | 11°5E | 20 | 11.5 = 11.5E | XY | YX |
| STRIKE from Hz | 10°E | | | | |

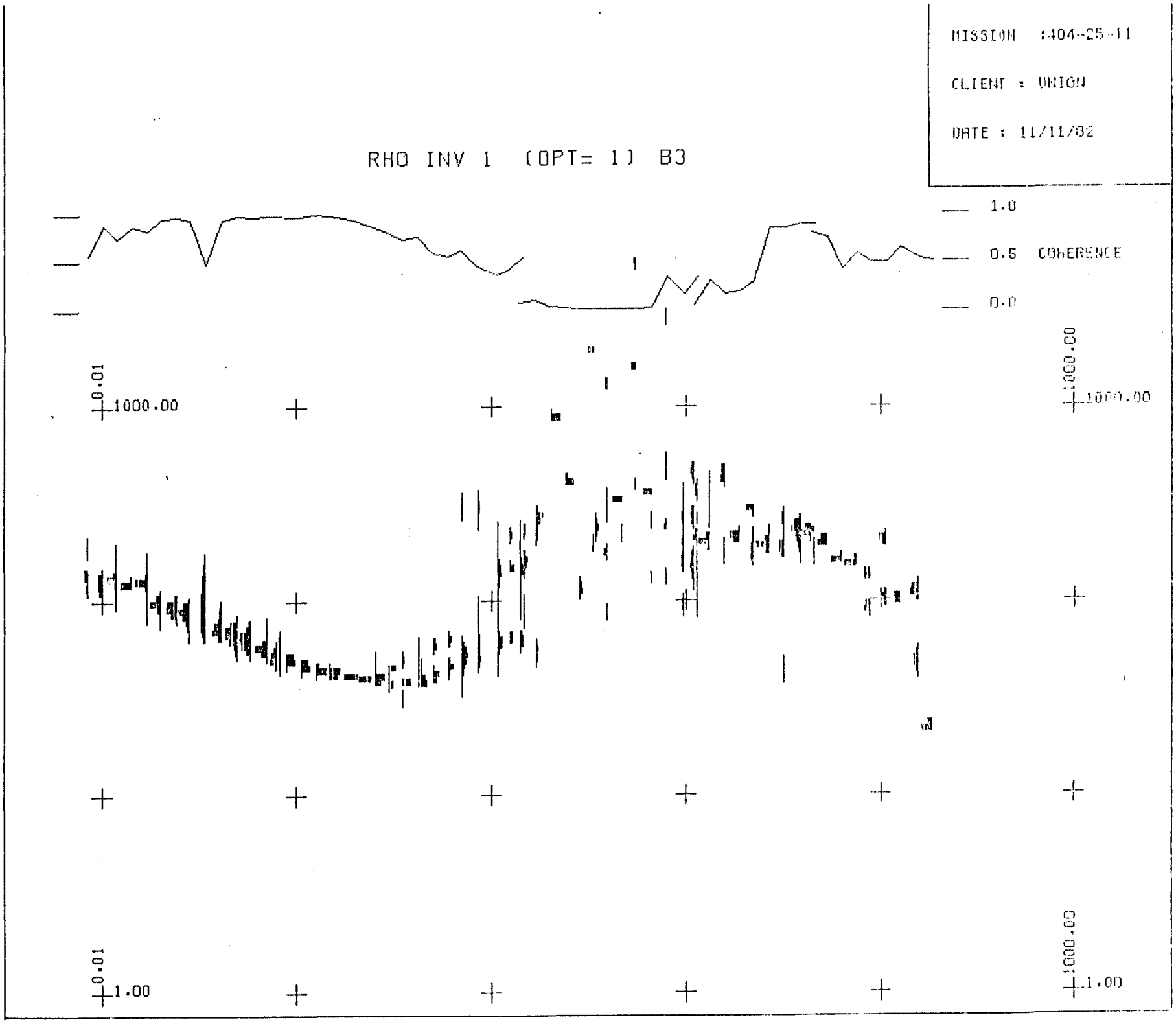
## COMMENTS

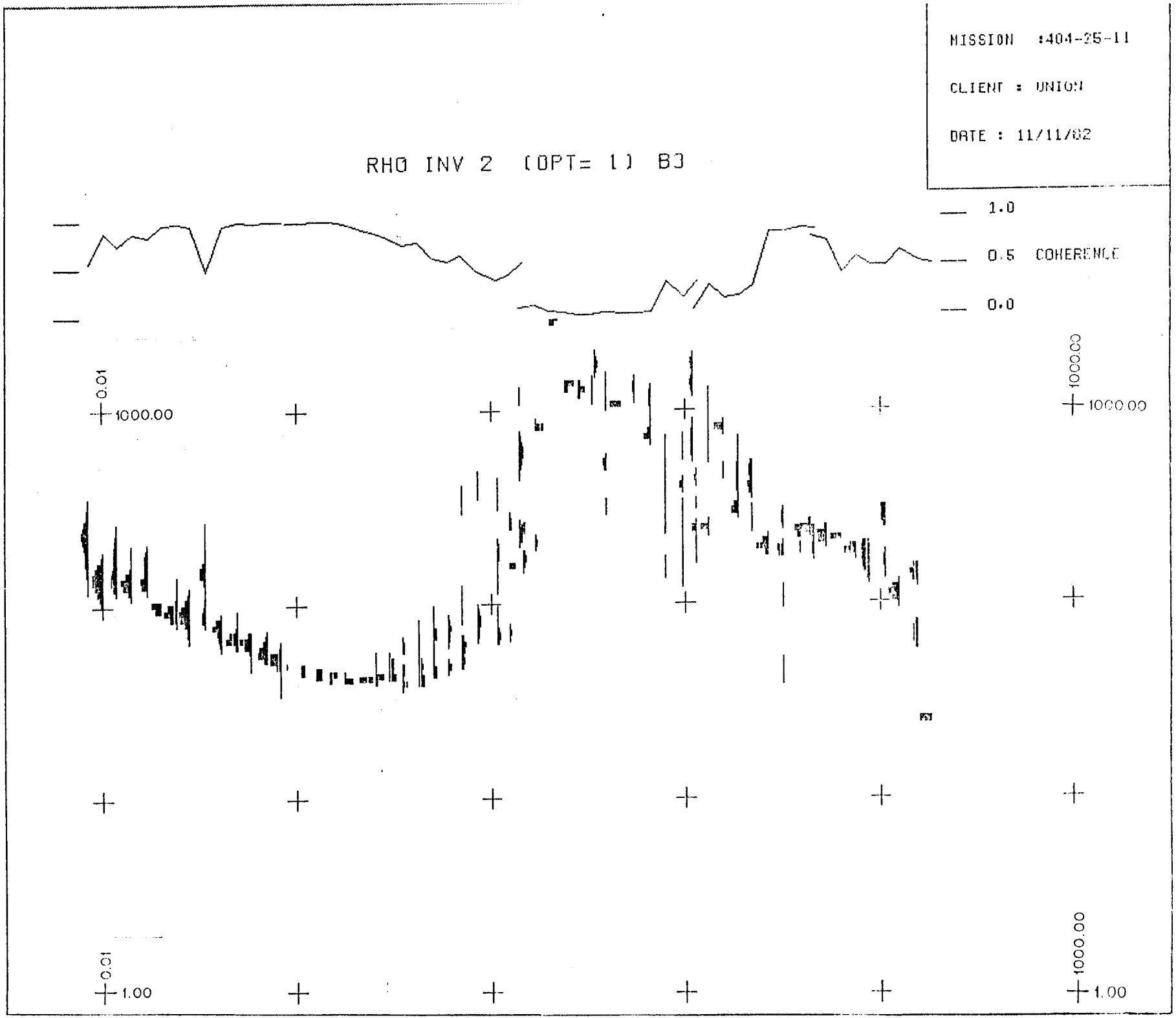
### FIELD

In a forest - wind
clouds - light thunderstorm

### PROCESSING

A and B both displayed
RHO INV, RHOYX = fair
RHO XY = poor
HF-LF = $\rho E < \rho H$ (superficial effect?)
HF-LF = $\phi E \# \phi H$
Tipper unreliable (noise)


MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/82
RHO INV 1 (OPT= 1) B3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

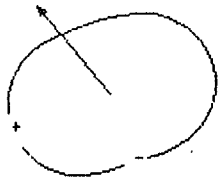

MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/82
RHO INV 2 (OPT= 1) B3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

DOMAINE HF
DECOUPAGE EN 12
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 355GR
SKEW = 0.235
TIPPER = 0.156
COMBINAISON 1

MISSION : 3404-25-11
CLIENT : UNICOM
DATE : 27/11/92

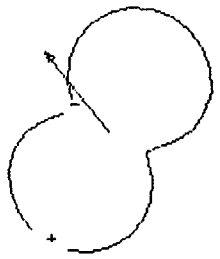
XY

MODULE 3.125 VAL. CENTRALE LO. AZIMUT DU MINIMUM 162°
MAXI 81.0 RNS ROT (MINIMUM) 160°



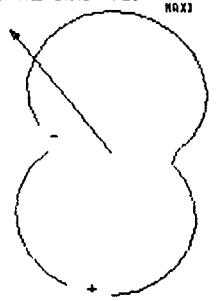
XX

MODULE 1.652 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 299°
MAXI 13.38 RNS ROT (MINIMUM) 20°



YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 155°
MAXI 0.163 RNS ROT (MAXIMUM) 130°



SKEW = 0.486
TIPPER = 0.152
COMBINAISON 2

XY

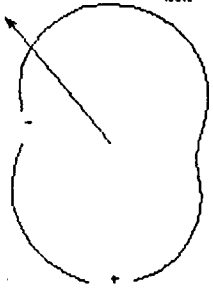
MODULE 0.781 VAL. CENTRALE LO. AZIMUT DU MINIMUM 302°
MAXI 3845.1 RNS ROT (MINIMUM) 10°

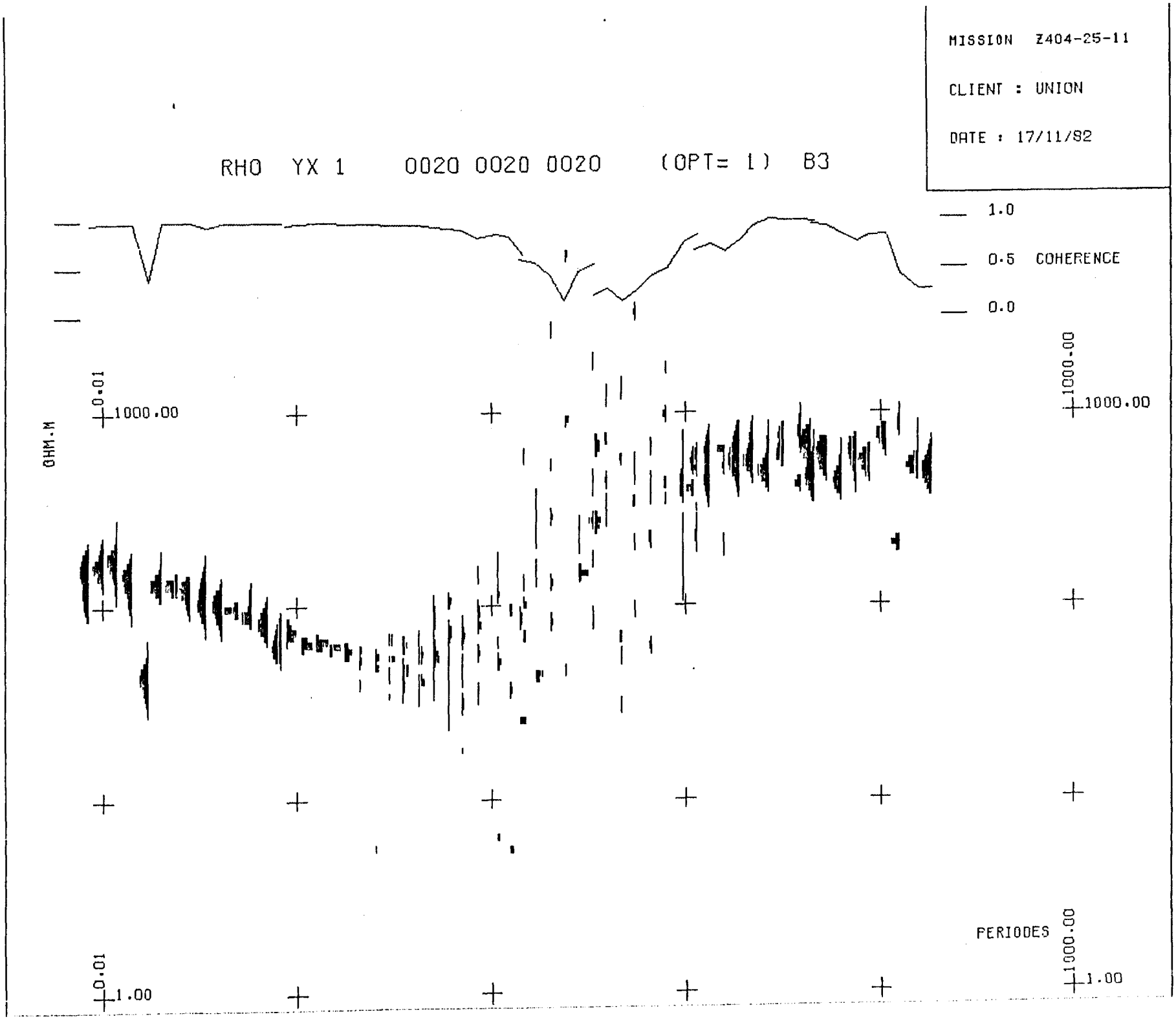
XX

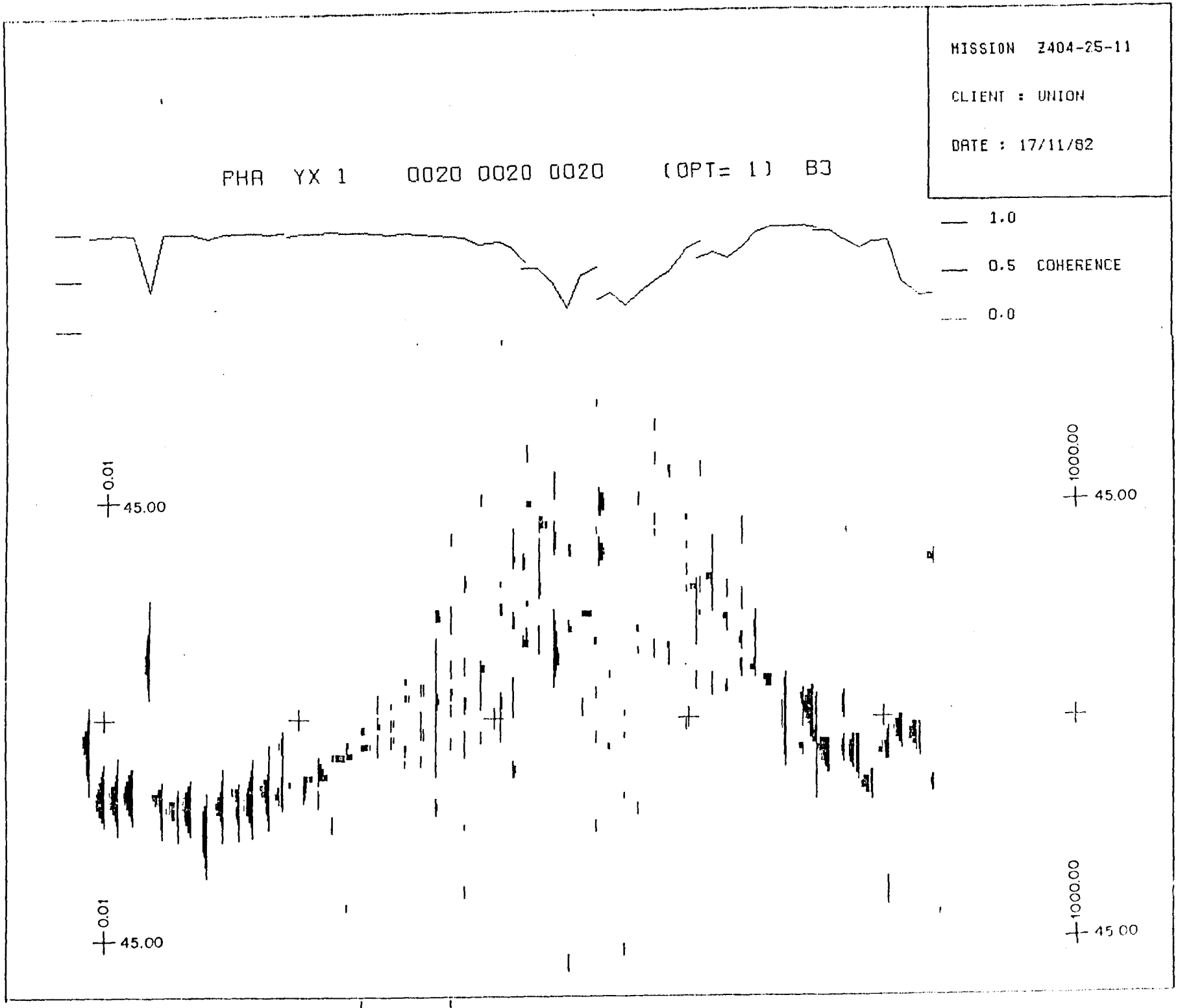
MODULE 1.652 VAL. CENTRALE LO. AZIMUT DU MINIMUM 299°
MAXI 2423.8 RNS ROT (MINIMUM) 20°

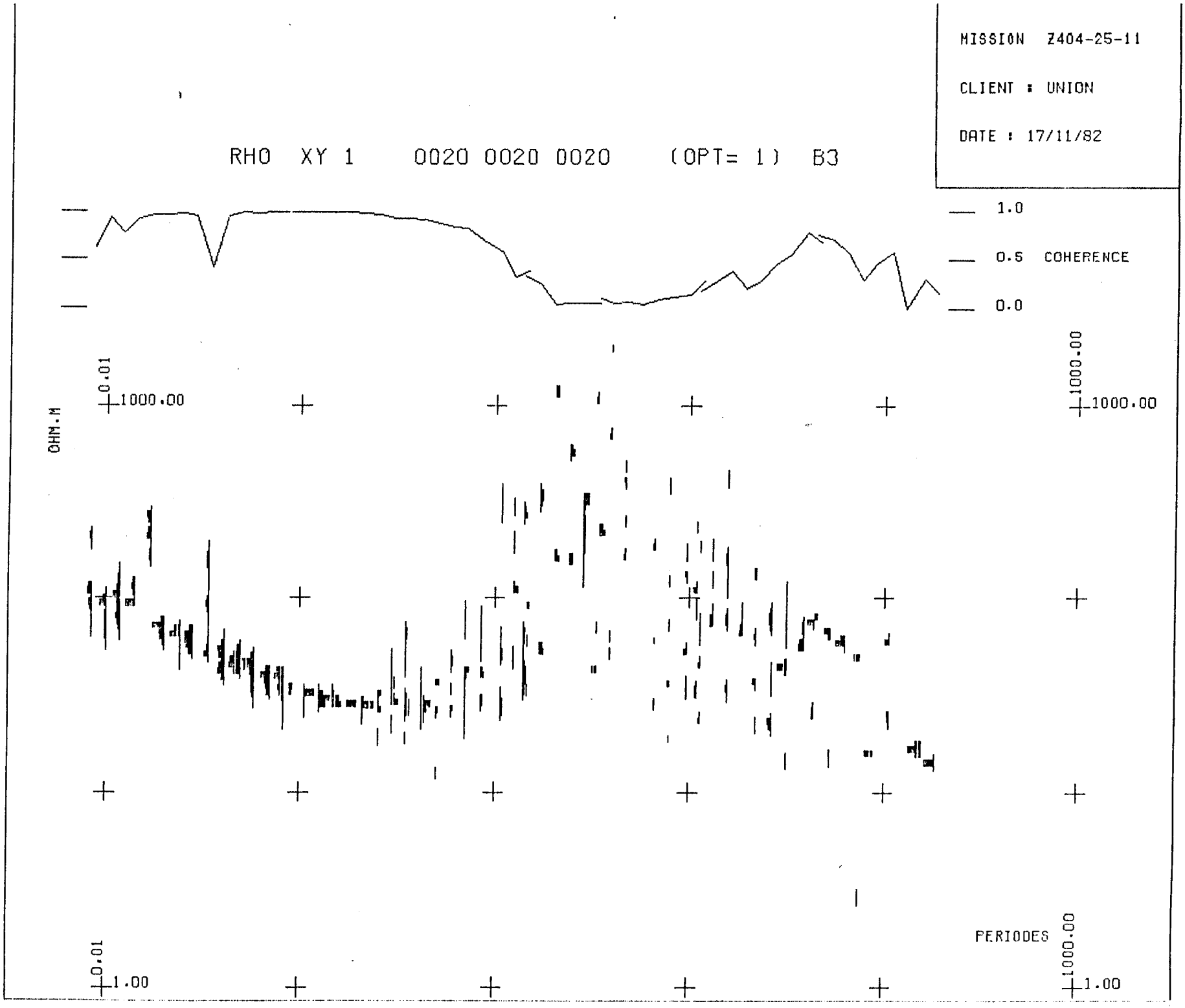
YZ

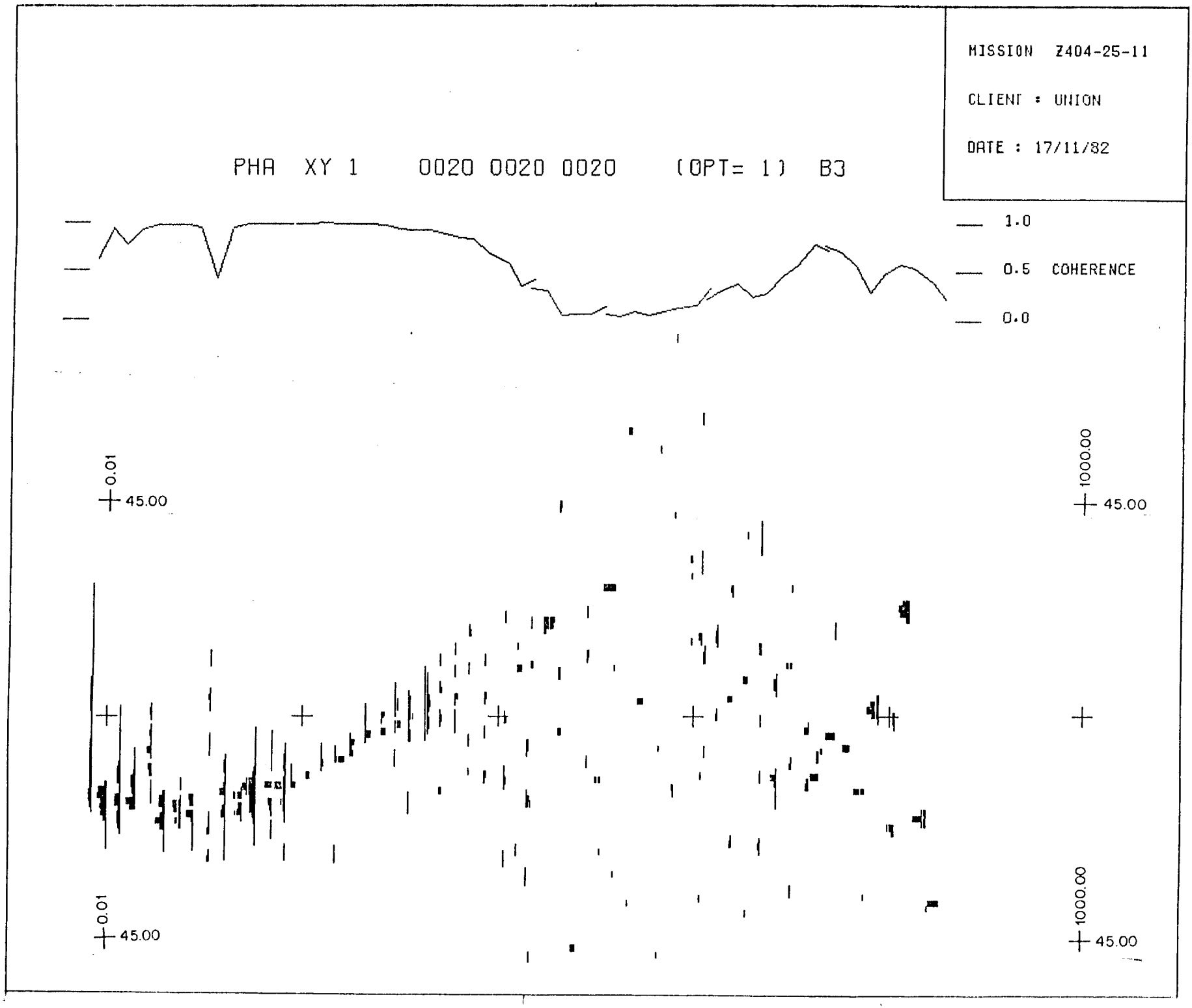
MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 175°
MAXI 0.148 RNS ROT (MAXIMUM) 140°

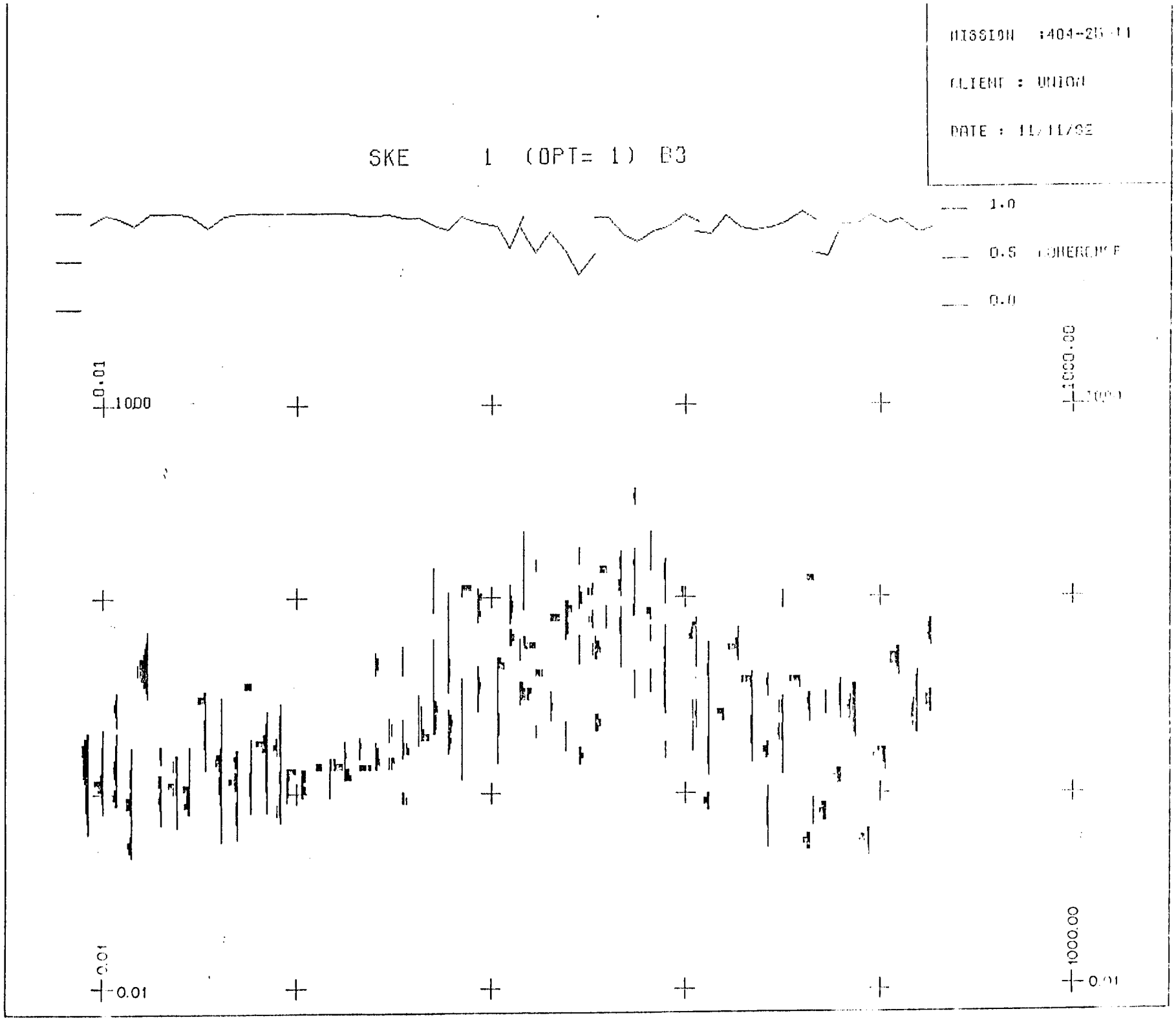


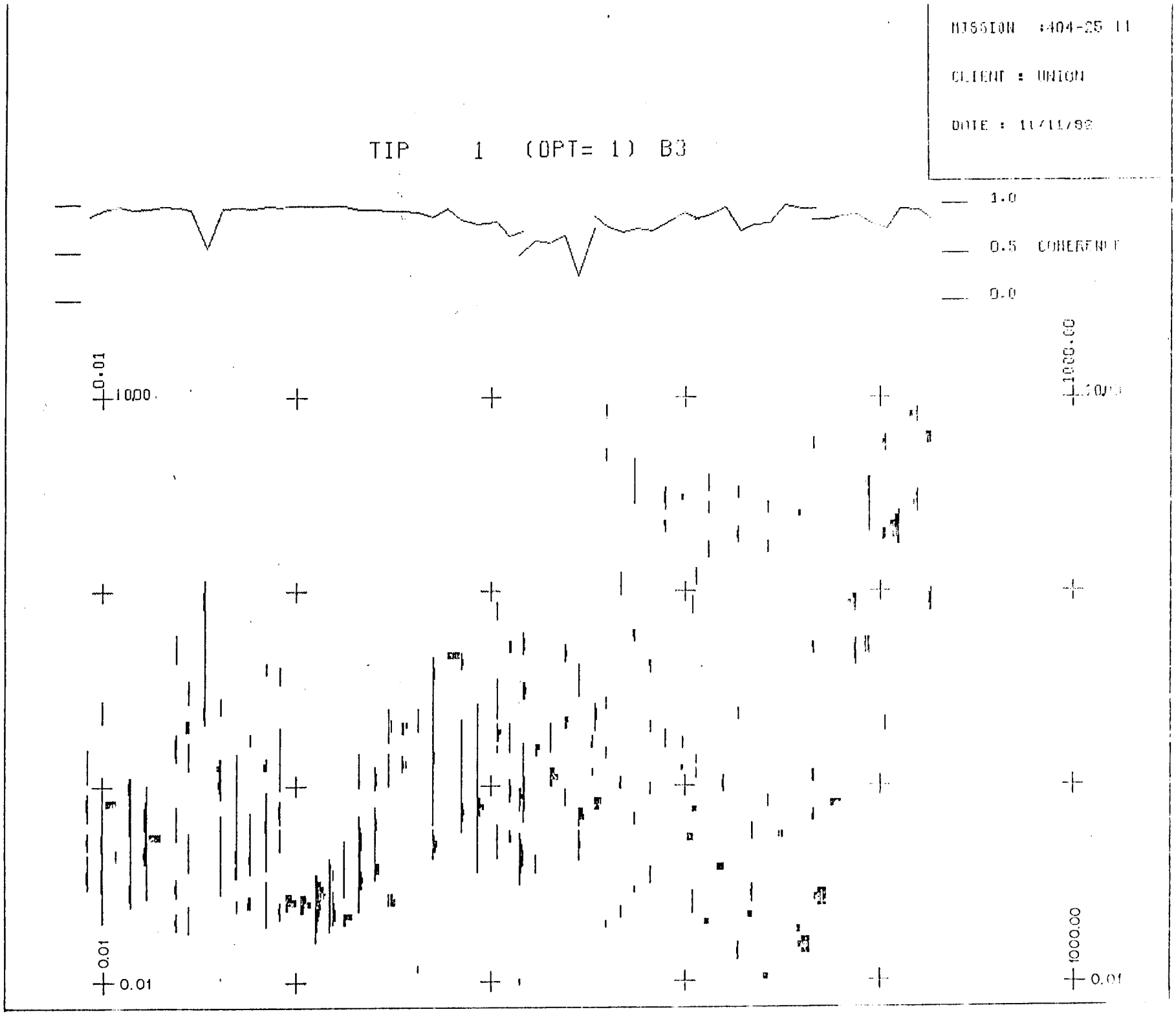

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/92
RHO YX 1 0020 0020 0020 (OPT= 1) B3
1.0
0.5 COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
PHR YX 1 0020 0020 0020 (OPT= 1) B3
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO XY 1 0020 0020 0020 (OPT= 1) B3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
PHA XY 1 0020 0020 0020 (OPT= 1) B3
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/92
SKE 1 (OPT= 1) B3
1.0
0.5 CONERCHE
0.0
0.01
1000
1000.00
0.01
1000.00
0.01

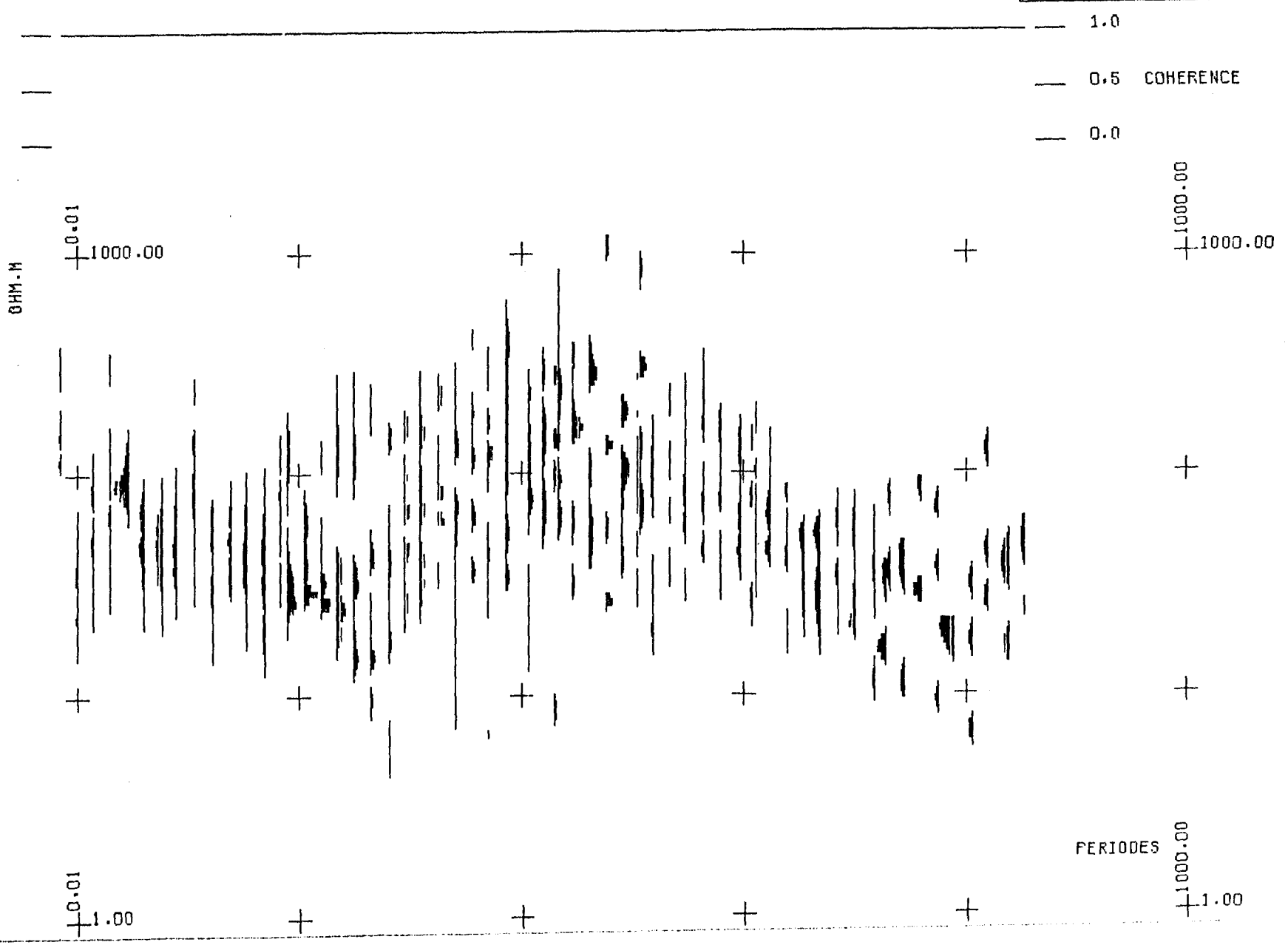

MISSION :404-25 11
CLIENT : UNION
DATE : 11/11/92
TIP 1 (OPT= 1) B3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
0.01
1000.00
0.01

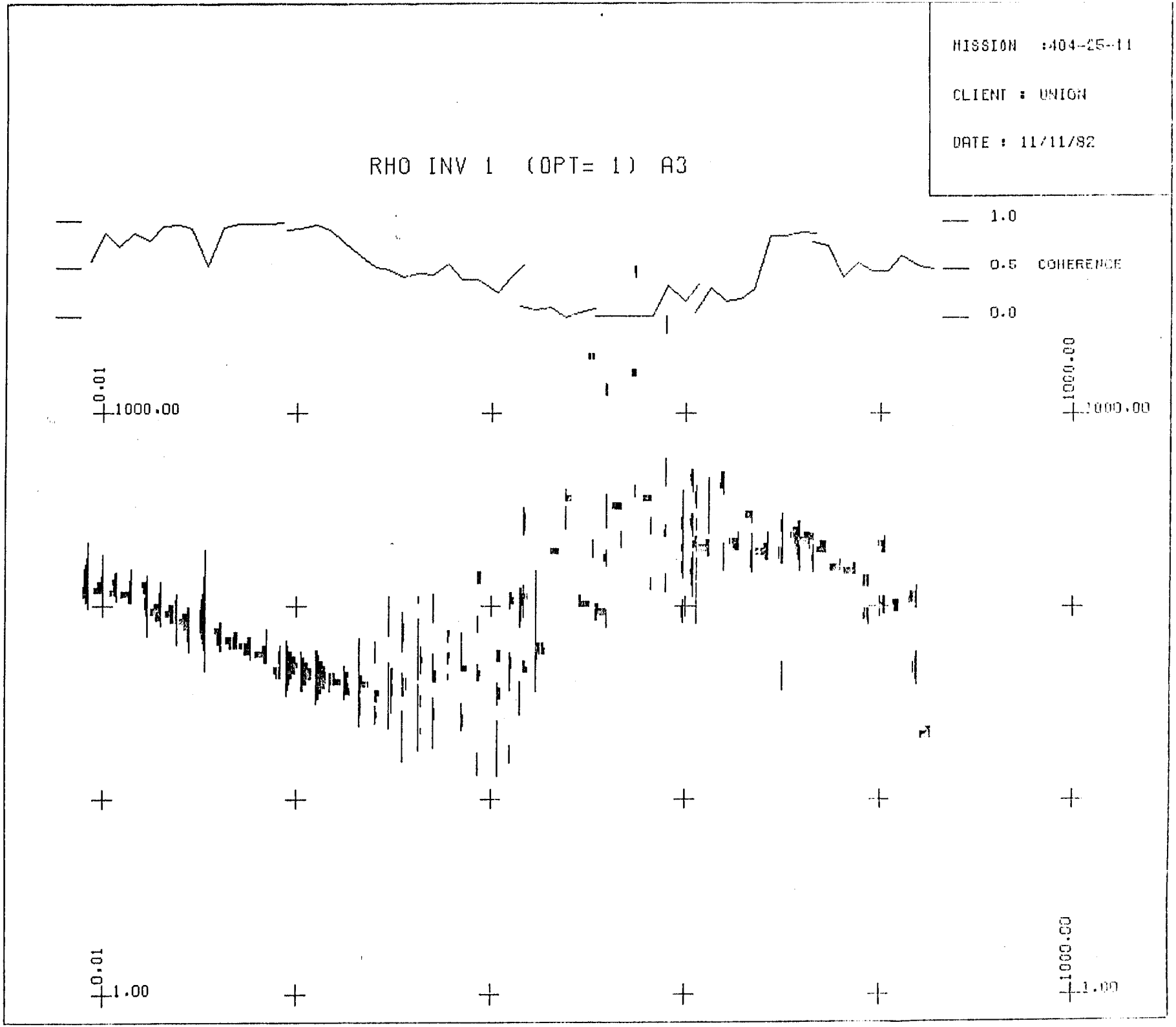
MISSION Z404-25-11

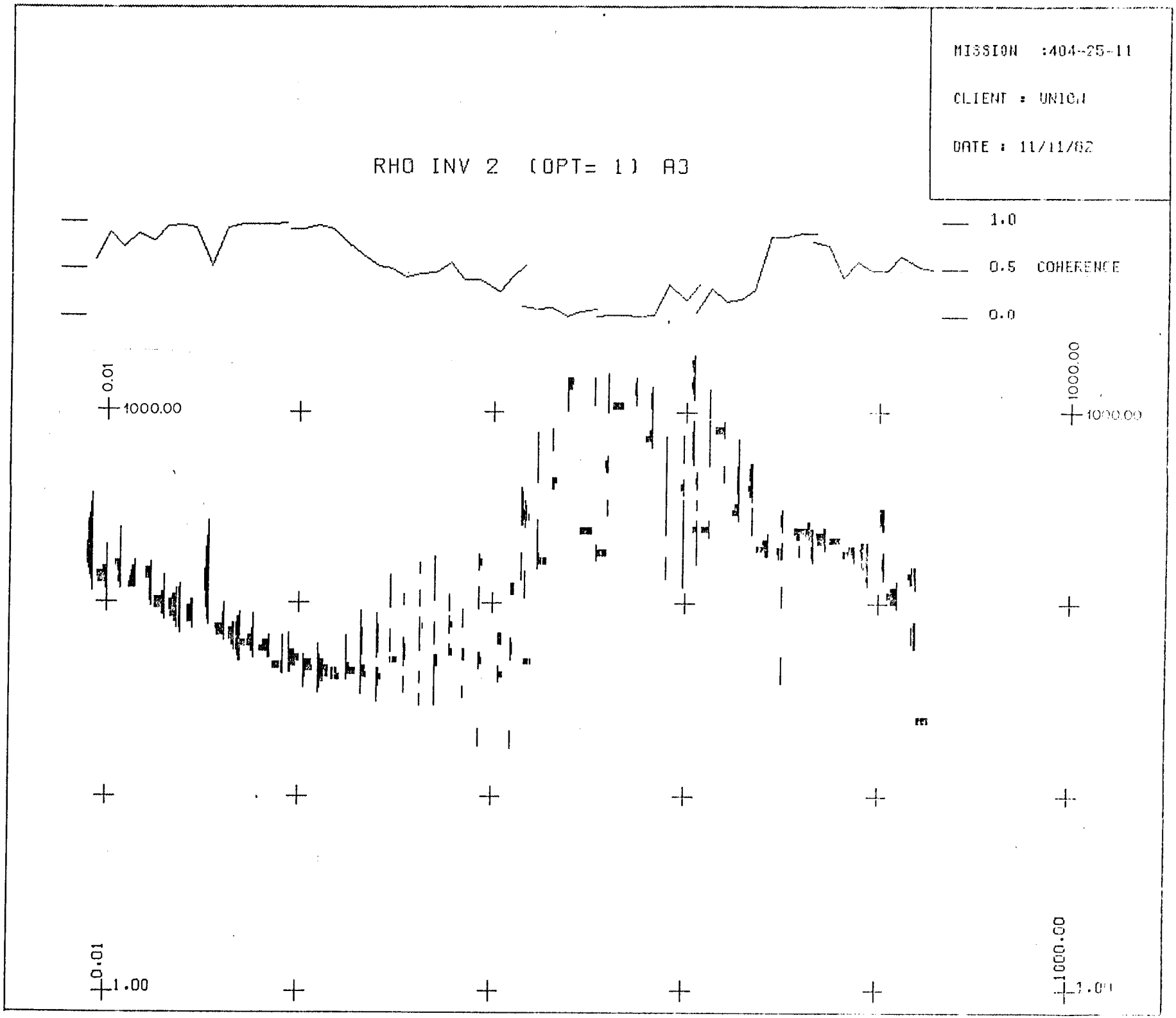
CLIENT : UNION

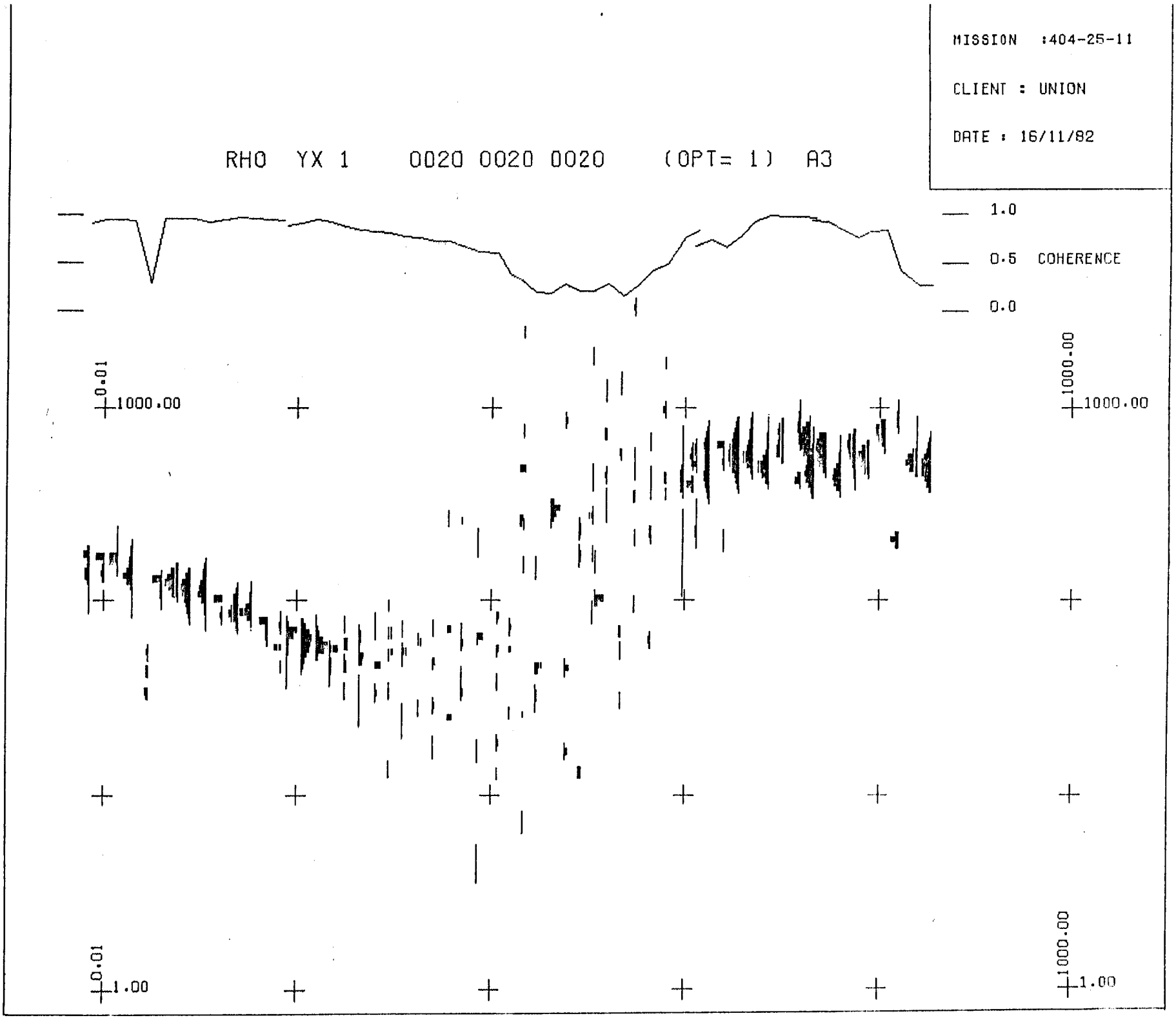
DATE : 17/11/82

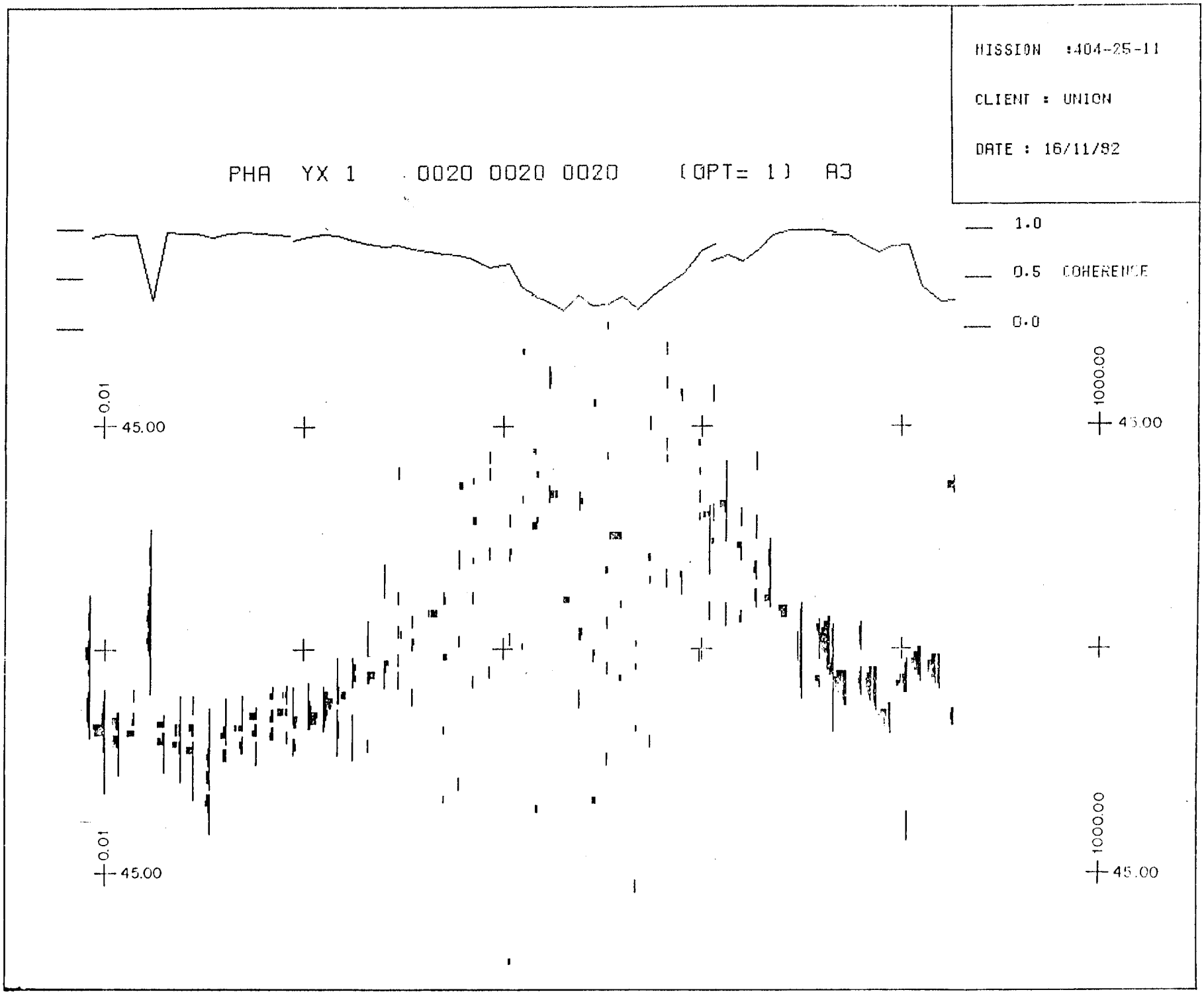
ELL*100 1 0020 0020 0020 (OPT= 1) B3

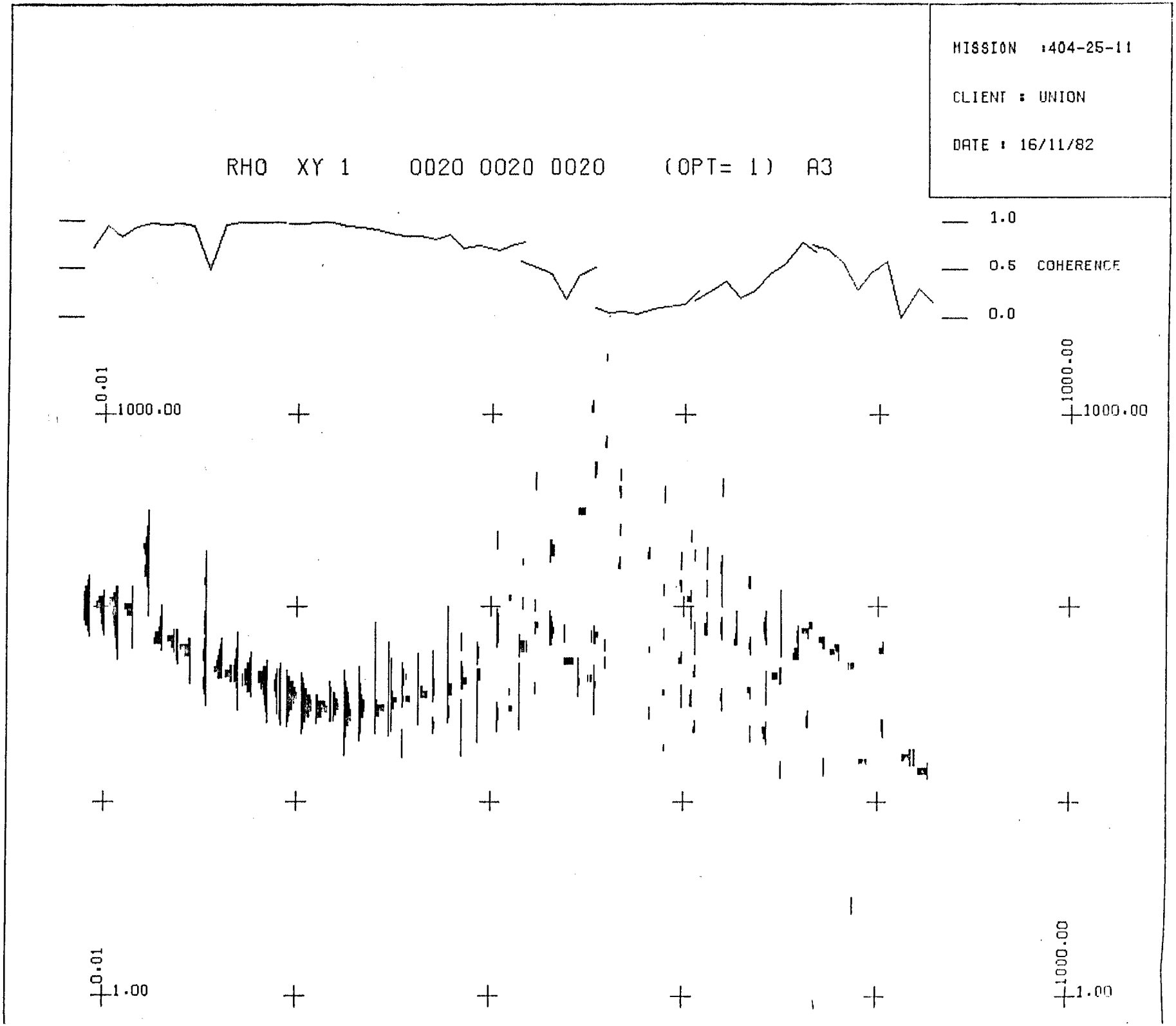


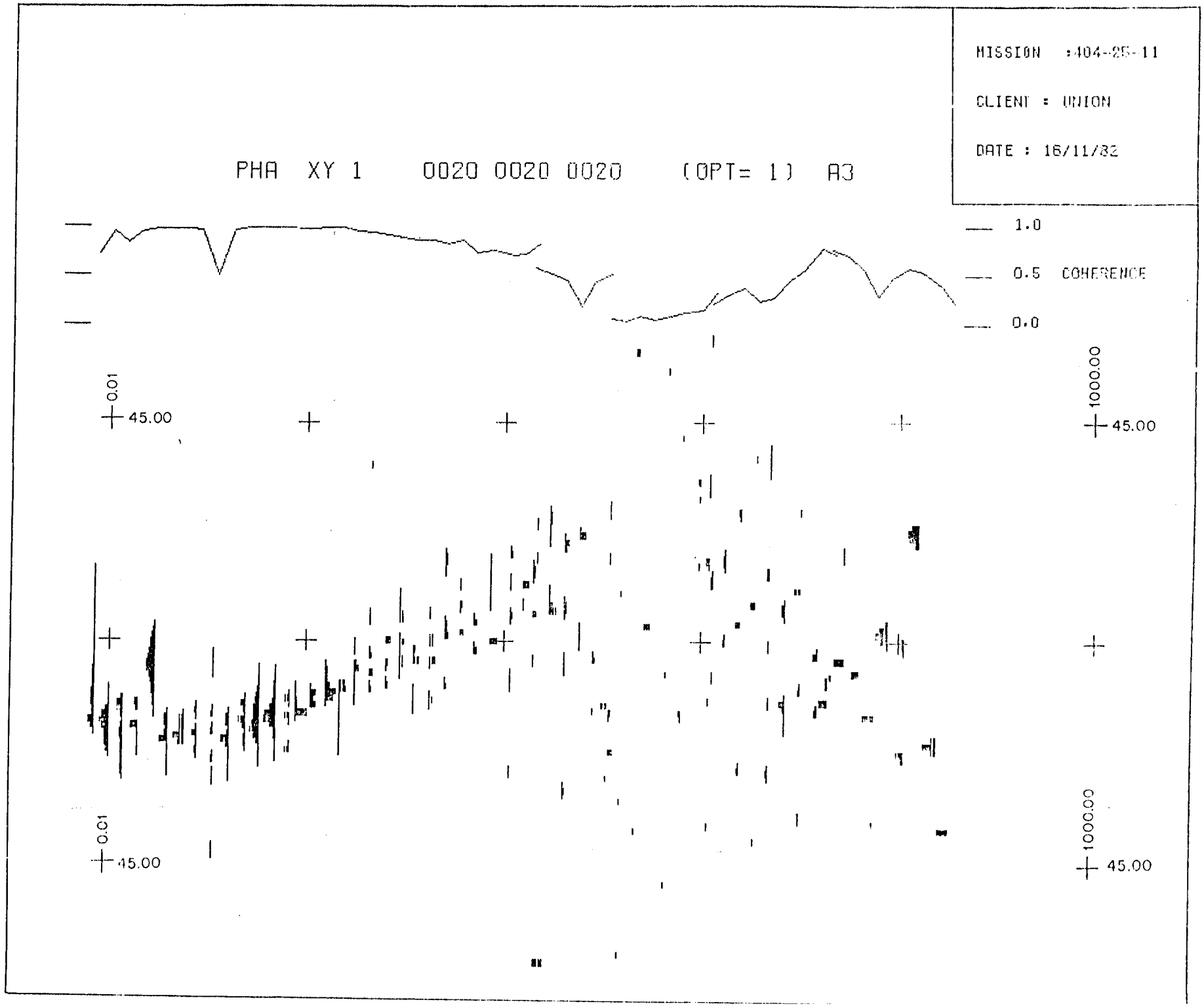

MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/82
RHO INV 1 (OPT= 1) A3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

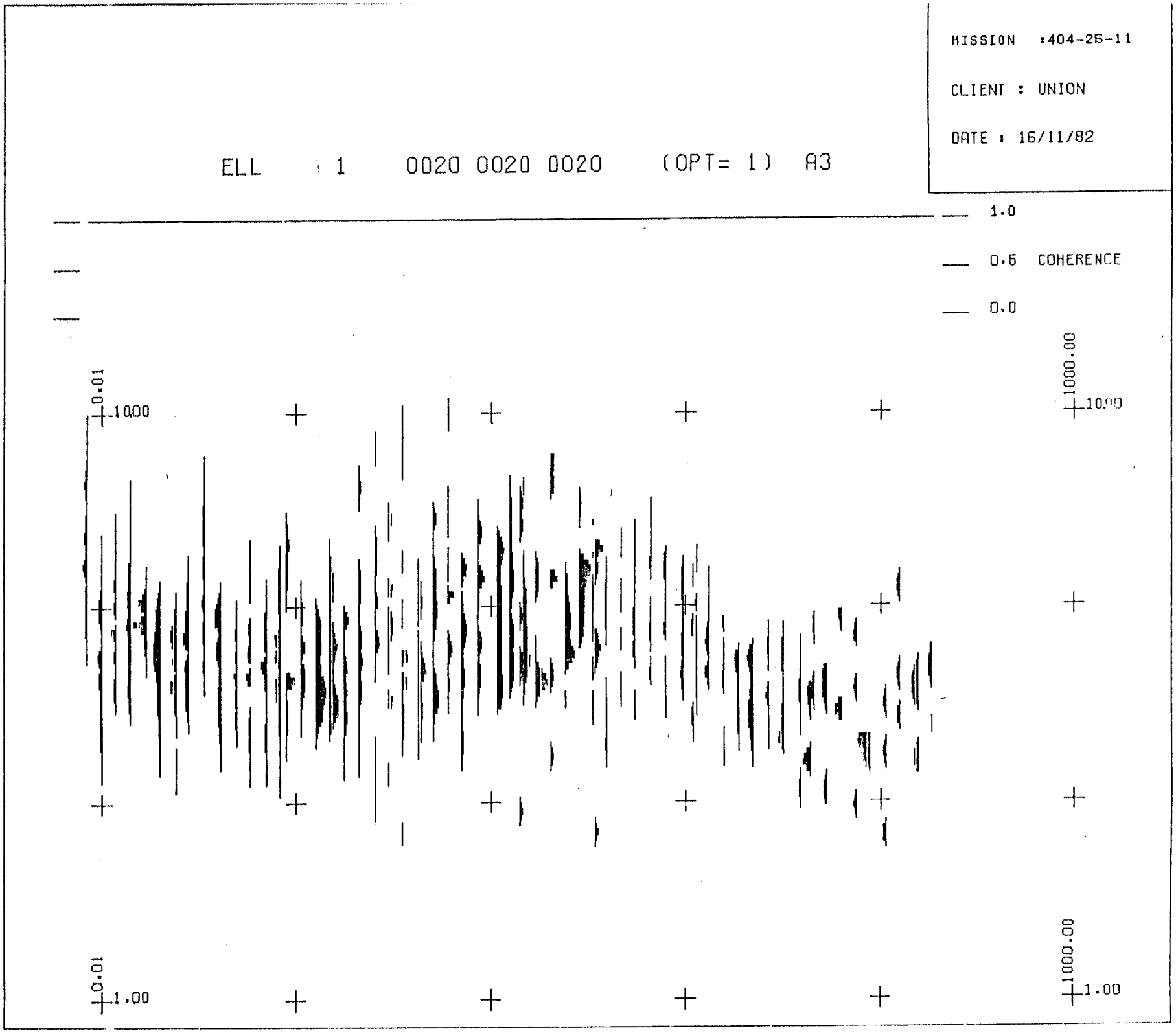

MISSION :404-25-11
CLIENT : UNICAL
DATE : 11/11/82
RHO INV 2 (OPT= 1) A3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
RHO YX 1 0020 0020 0020 (OPT= 1) A3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
PHA YX 1 0020 0020 0020 (OPT= 1) A3
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
RHO XY 1 0020 0020 0020 (OPT= 1) A3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
PHA XY 1 0020 0020 0020 (OPT= 1) A3
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
ELL 1 0020 0020 0020 (OPT= 1) A3
1.0
0.5 COHERENCE
0.0
0.01
1000.00
10.00
0.01
1000.00
1.00

MISSION : 404-25-11
CLIENT : UNION
DATE : 11/11/82

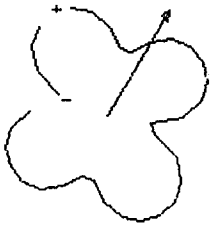
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 35gm
SKEW = 0.021
TIPPER = 0.384
COMBINAISON 1

XY

MODULE 1.662 VAL. CENTRALE 10. AZIMUT DU MINIMUM 11g
MAXI 484.8 AMO ROT (MINIMUM) 20g

XX

MODULE 1.662 VAL. CENTRALE 1. AZIMUT DU MINIMUM 200g
MAXI 85.3 AMO ROT (MINIMUM) 110g



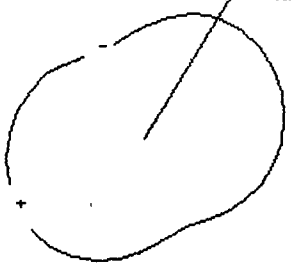
YZ

MODULE 0.155 VAL. CENTRALE 0.1 AZIMUT DU MAXIMUM 21g
MAXI 0.44 AMO ROT (MAXIMUM) 10g

SKEW = 0.084
TIPPER = 0.438
COMBINAISON 2

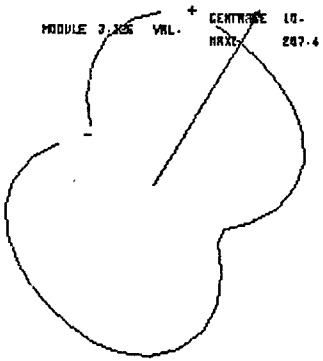
XY

MODULE 9.126 VAL. CENTRALE 100. AZIMUT DU MINIMUM 328g
MAXI 1619.6 AMO ROT (MINIMUM) 80g



XX

MODULE 3.326 VAL. CENTRALE 10. AZIMUT DU MINIMUM 302g
MAXI 287.4 AMO ROT (MINIMUM) 80g



YZ

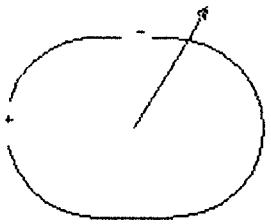
MODULE 0.126 VAL. CENTRALE 0.1 AZIMUT DU MAXIMUM 322g
MAXI 0.83 AMO ROT (MAXIMUM) 170g

STATION A3
DOMAINE NF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 35gr
SKEW = 0.115
TIPPER = 0.137
COMBINAISON 1

MISSION : 404-25-11
CLIENT : UNION
DATE : 11/11/82

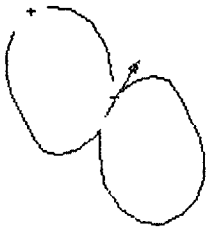
XY

MODULE 3.125 VAL. CENTRALE LO. AZIMUT DU MINIMUM 1°
MAXI 131.2 ANG ROT (MINIMUM) 90°



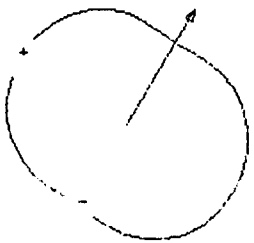
XX

MODULE 3.125 VAL. CENTRALE L- AZIMUT DU MINIMUM 21°
MAXI 11.0 ANG ROT (MINIMUM) 70°



YZ

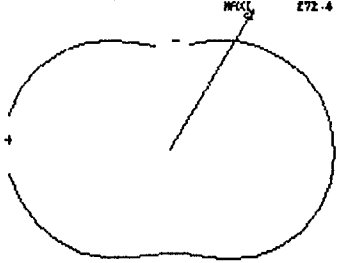
MODULE 3.125 VAL. CENTRALE 0-01 AZIMUT DU MAXIMUM 302°
MAXI 0.122 ANG ROT (MAXIMUM) 80°



SKEW = 0.154
TIPPER = 0.144
COMBINAISON 2

XY

MODULE 3.125 VAL. CENTRALE LO. AZIMUT DU MINIMUM 1°
MAXI 272.4 ANG ROT (MINIMUM) 90°

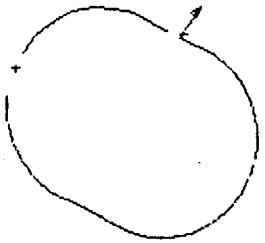


XX

MODULE 1.562 VAL. CENTRALE L- AZIMUT DU MINIMUM 222°
MAXI 38.0 ANG ROT (MINIMUM) 170°

YZ

MODULE 3.125 VAL. CENTRALE 0-01 AZIMUT DU MAXIMUM 282°
MAXI 0.131 ANG ROT (MAXIMUM) 180°

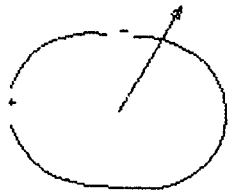


STATION A3
DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 35DR
SKEW = 0.110
TIPPER = 0.127
COMBINAISON 1

MISSION : 404-85-11
CLIENT : UNION
DATE : 11/11/82

XY

MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 1°
MAXI 67.8 RAG ROT (MINIMUM) 80°

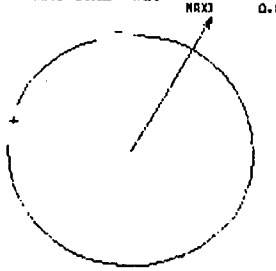


XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 282°
MAXI 5.83 RAG ROT (MINIMUM) 140°

YZ

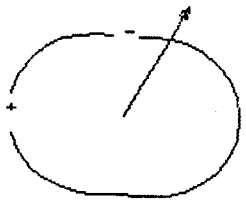
MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 282°
MAXI 0.118 RAG ROT (MAXIMUM) 110°



SKEW = 0.117
TIPPER = 0.134
COMBINAISON 2

XY

MODULE 5.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 1°
MAXI 101.4 RAG ROT (MINIMUM) 80°

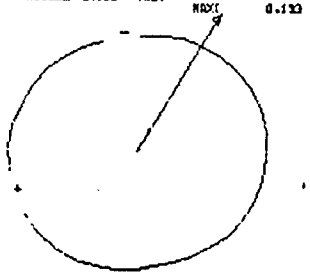


XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 21°
MAXI 7.75 RAG ROT (MINIMUM) 10°

YZ

MODULE 5.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 282°
MAXI 0.153 RAG ROT (MAXIMUM) 140°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 4

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/28 | 7 | A | 6 | A | 8 | A |
| | 10 | B | 9 | B | 11 | B |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 75 | 67.5 = 67°5E |
| | Ey | 375 | 337.5 = 22°5W |

| STRIKE | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| from Exy, Hxy | 27°5E | 130 | 297.5 = 62.5W | YX | XY |
| | | 80 (HF) | 347.5 = 12.5W | | |
| STRIKE from Hz | 38°E | | | | |

COMMENTS

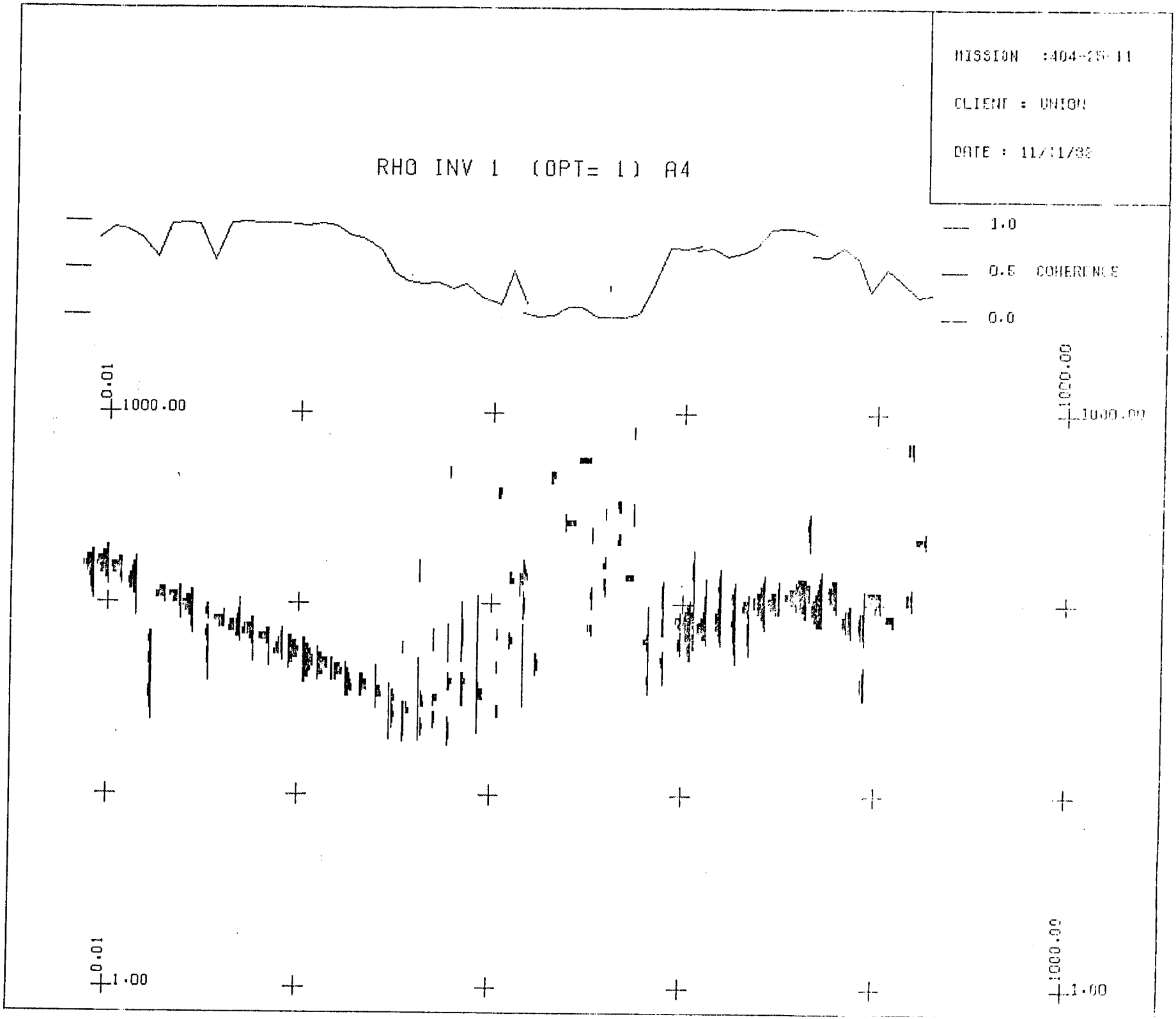
## FIELD

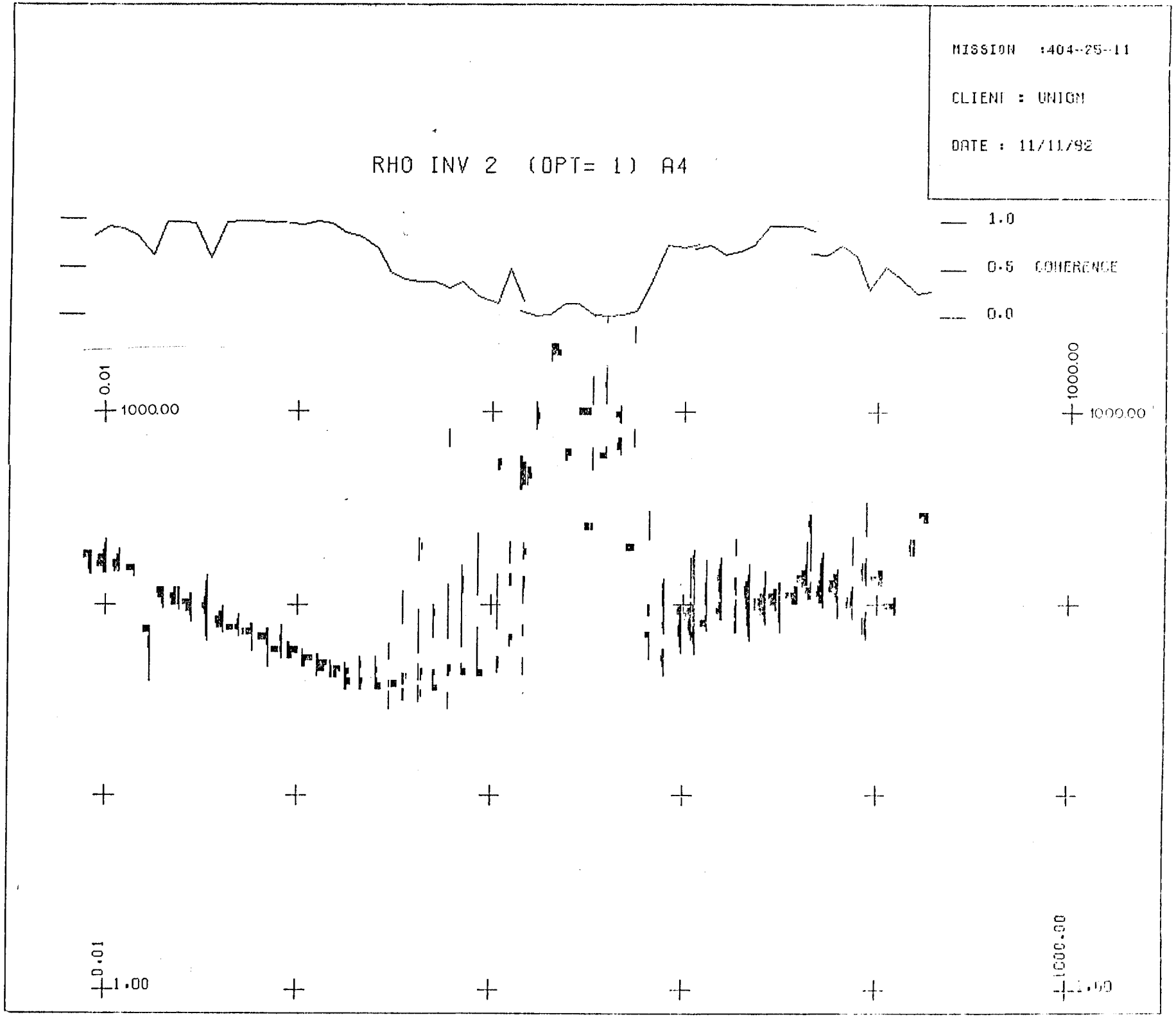
In a forest - unconsolidated soil
proximity of lava
clouds, light wind

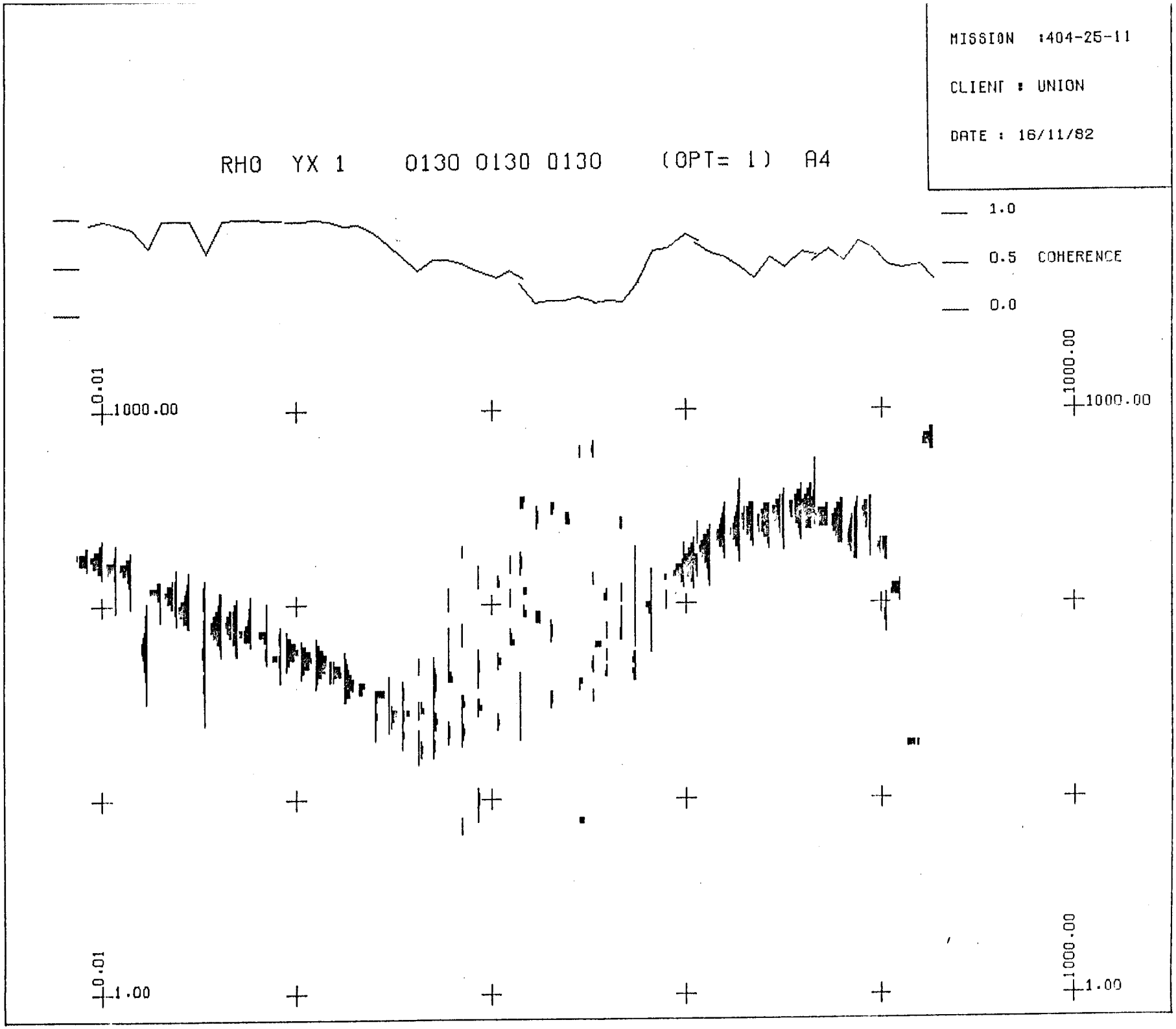
## PROCESSING

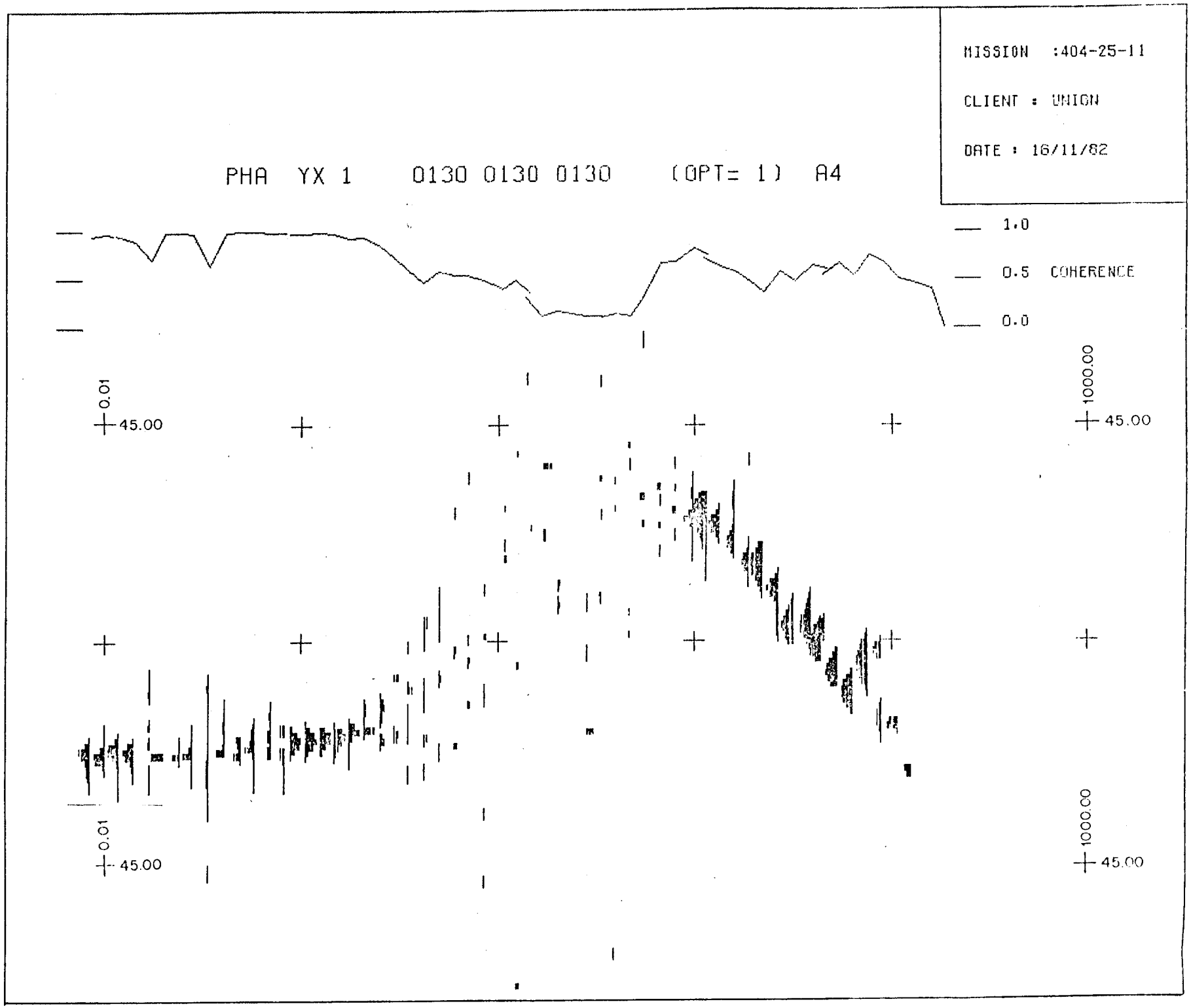
PINV and PYX = fair
PXY poor

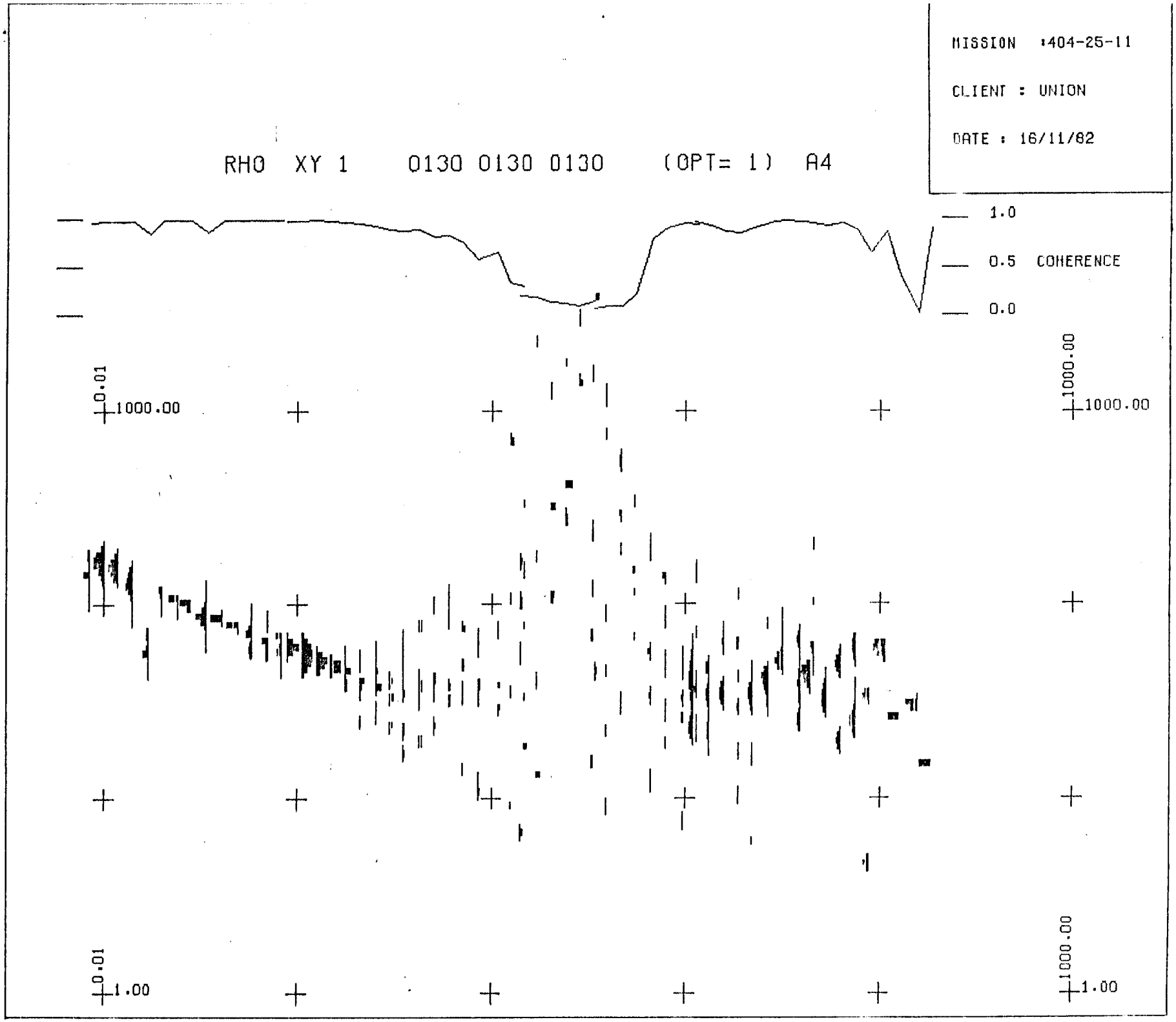
HF: ≠ strike
LF: $\rho E >> \rho H$

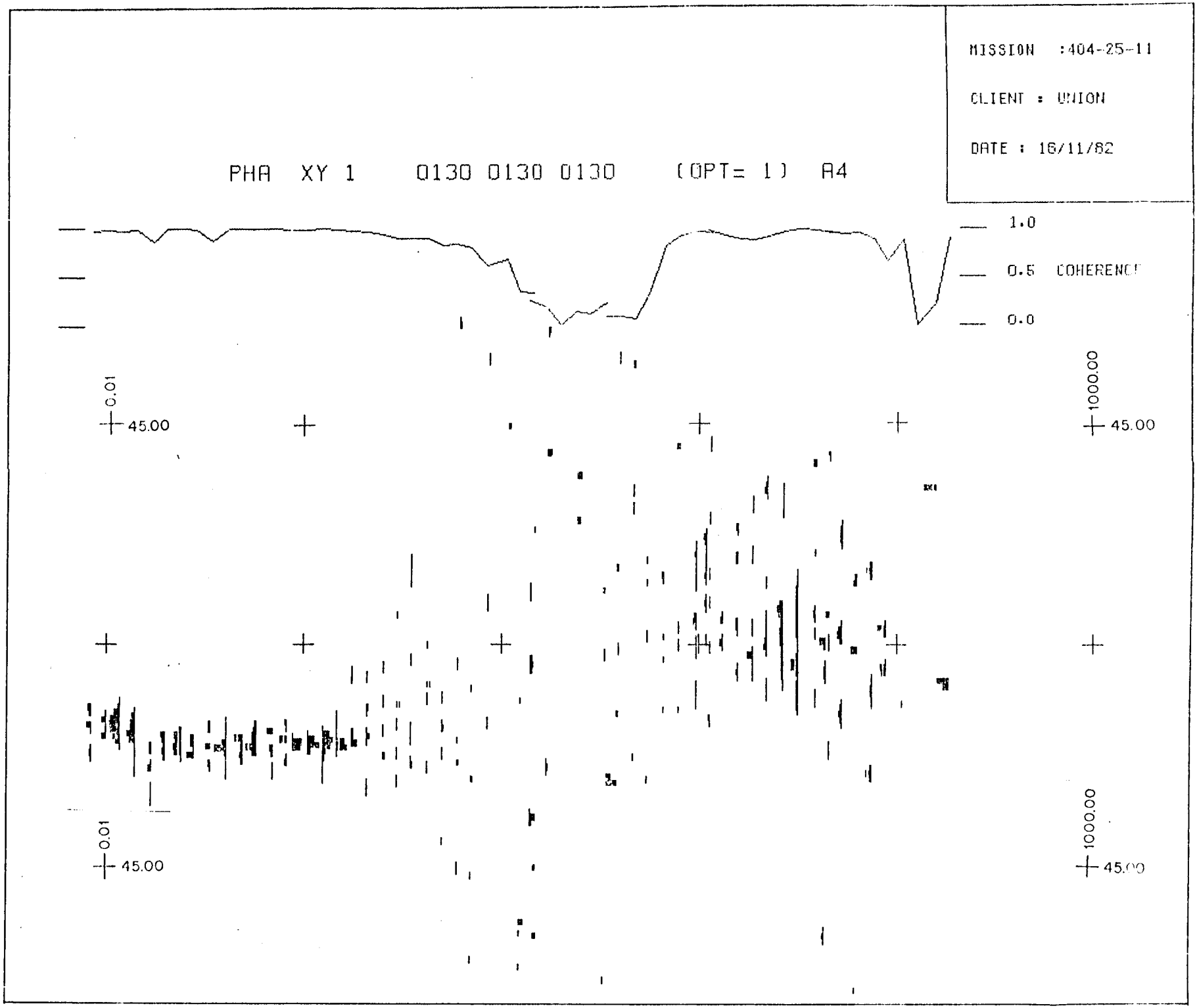

MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/88
RHO INV 1 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

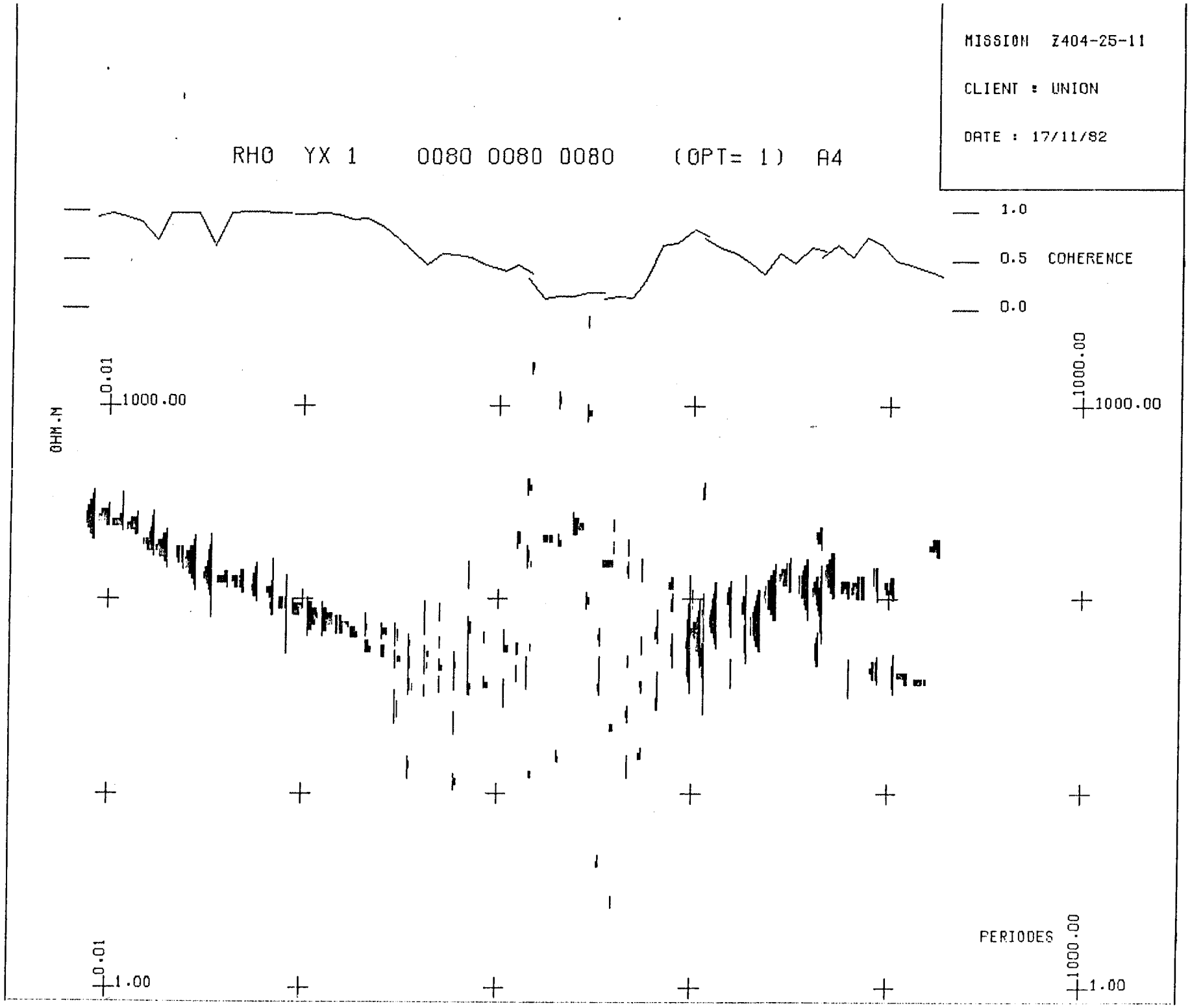

MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/92
RHO INV 2 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

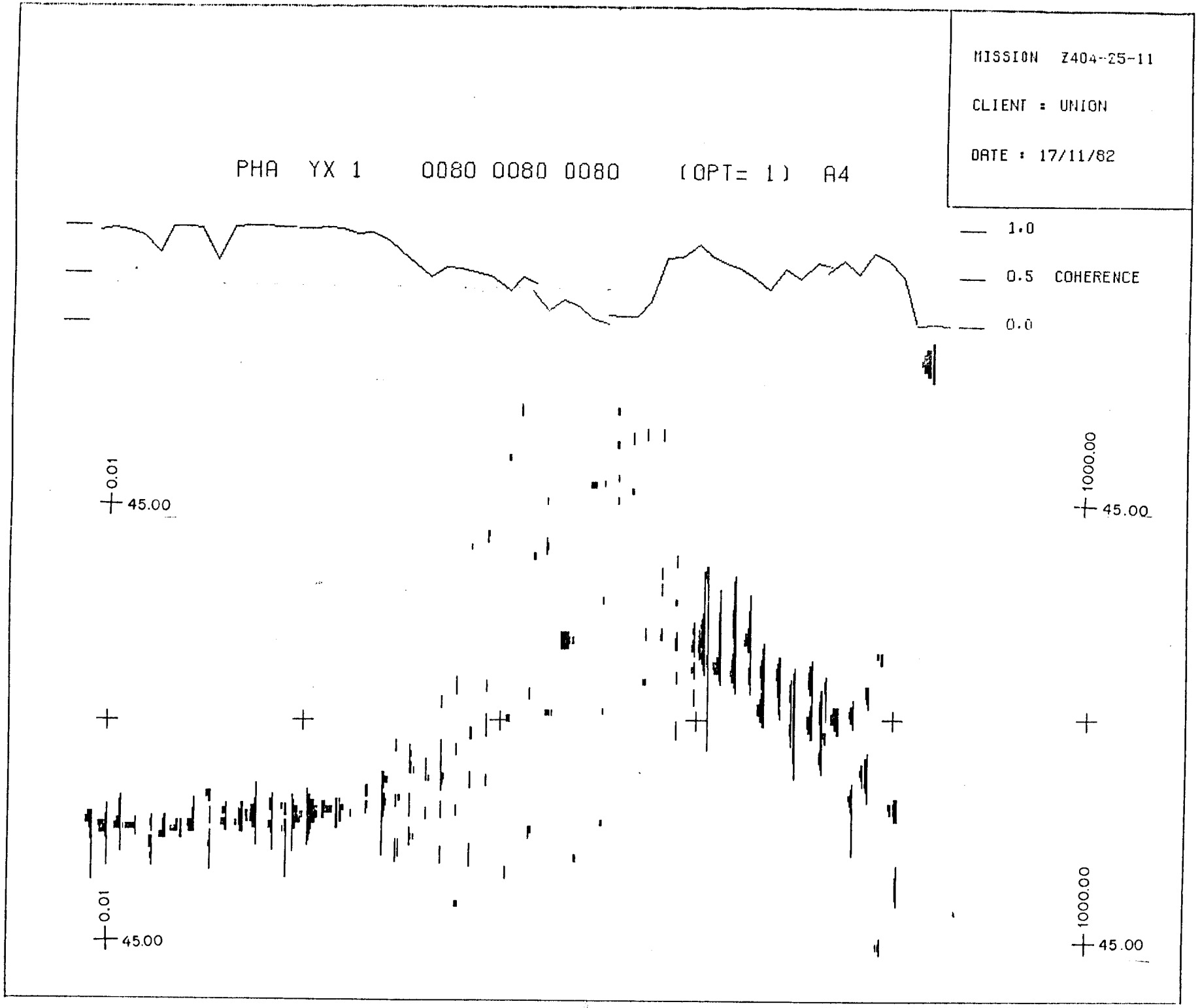

MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
RHO YX 1 0130 0130 0130 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

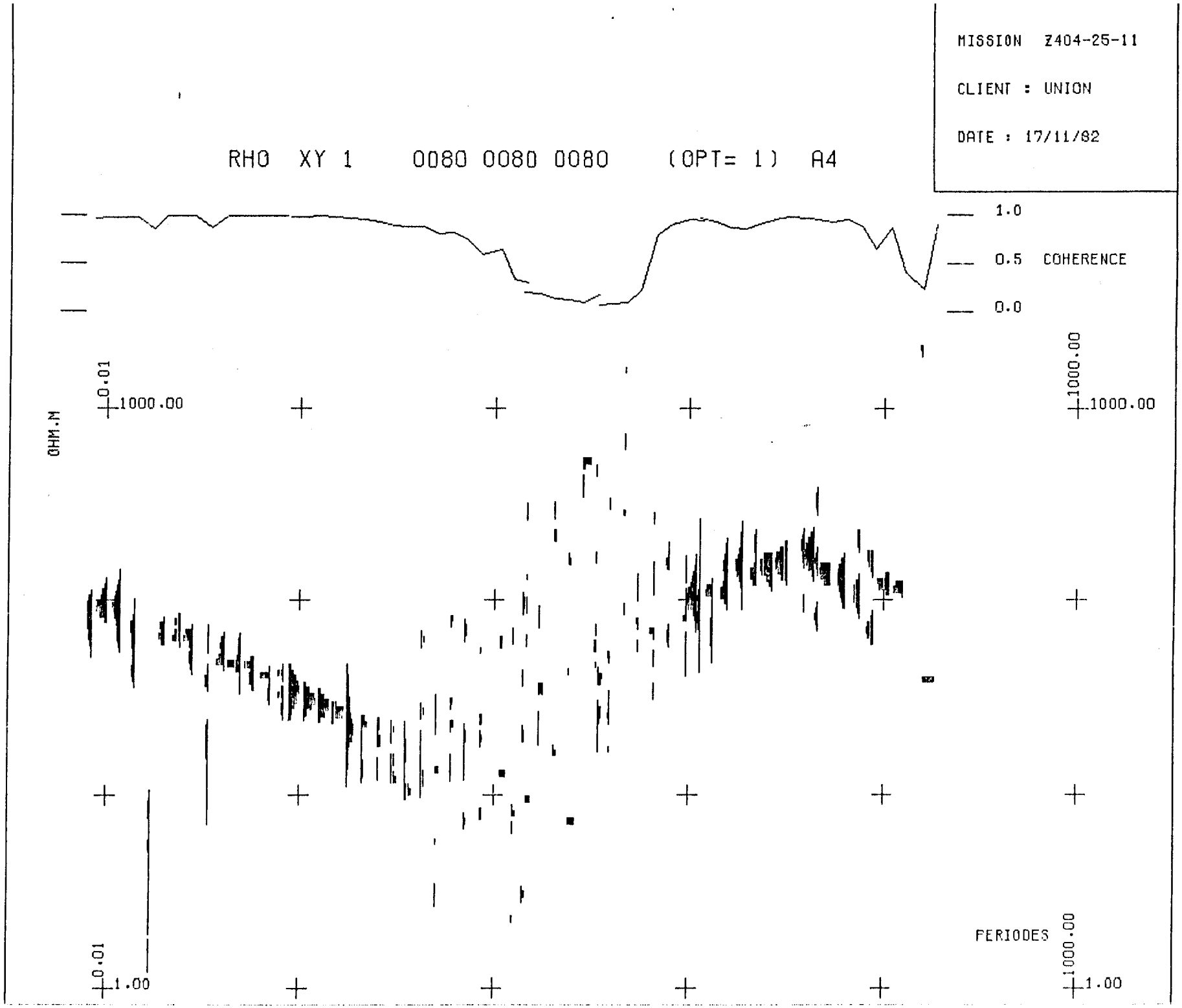

MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
PHA YX 1 0130 0130 0130 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

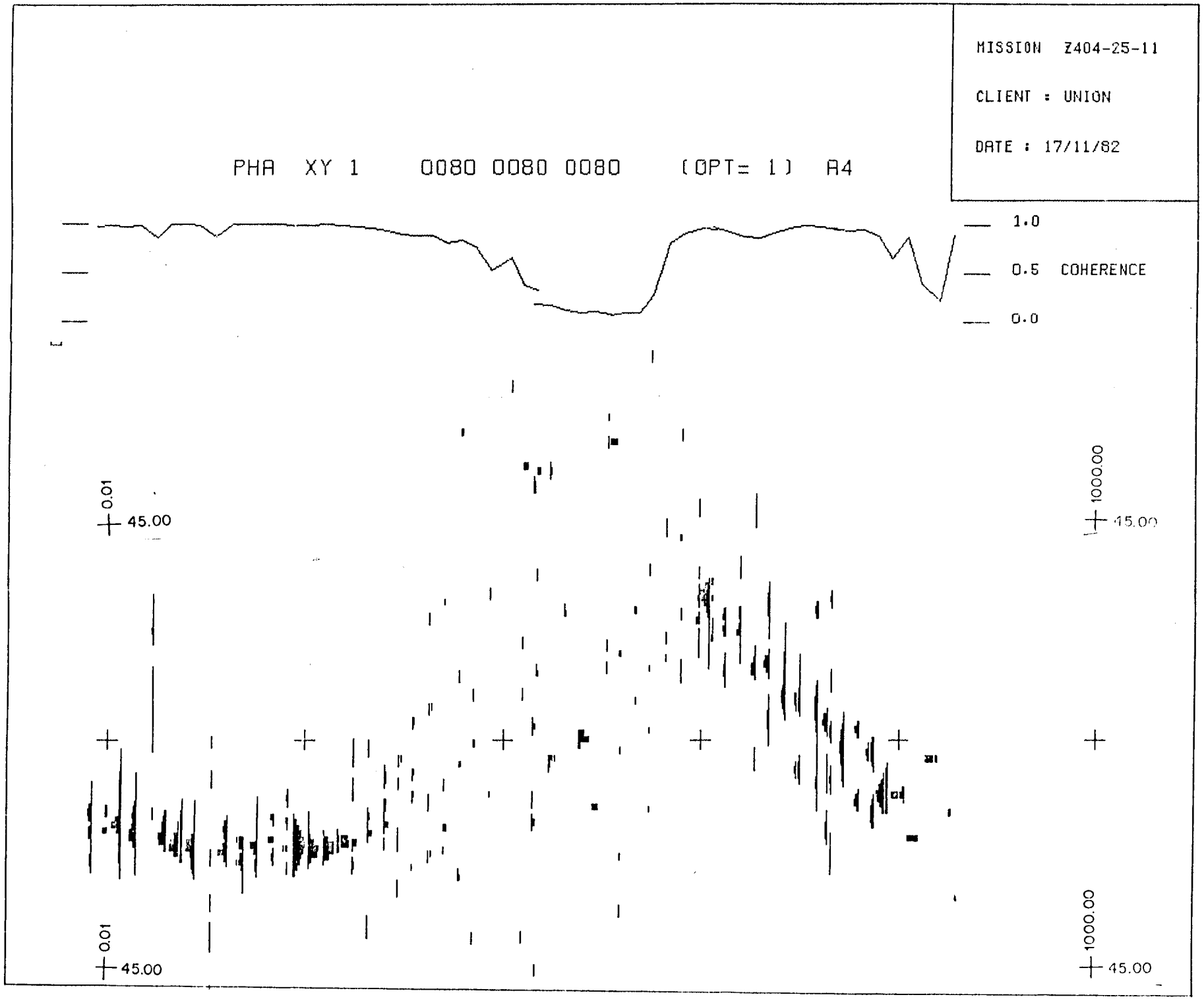

MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
RHO XY 1 0130 0130 0130 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

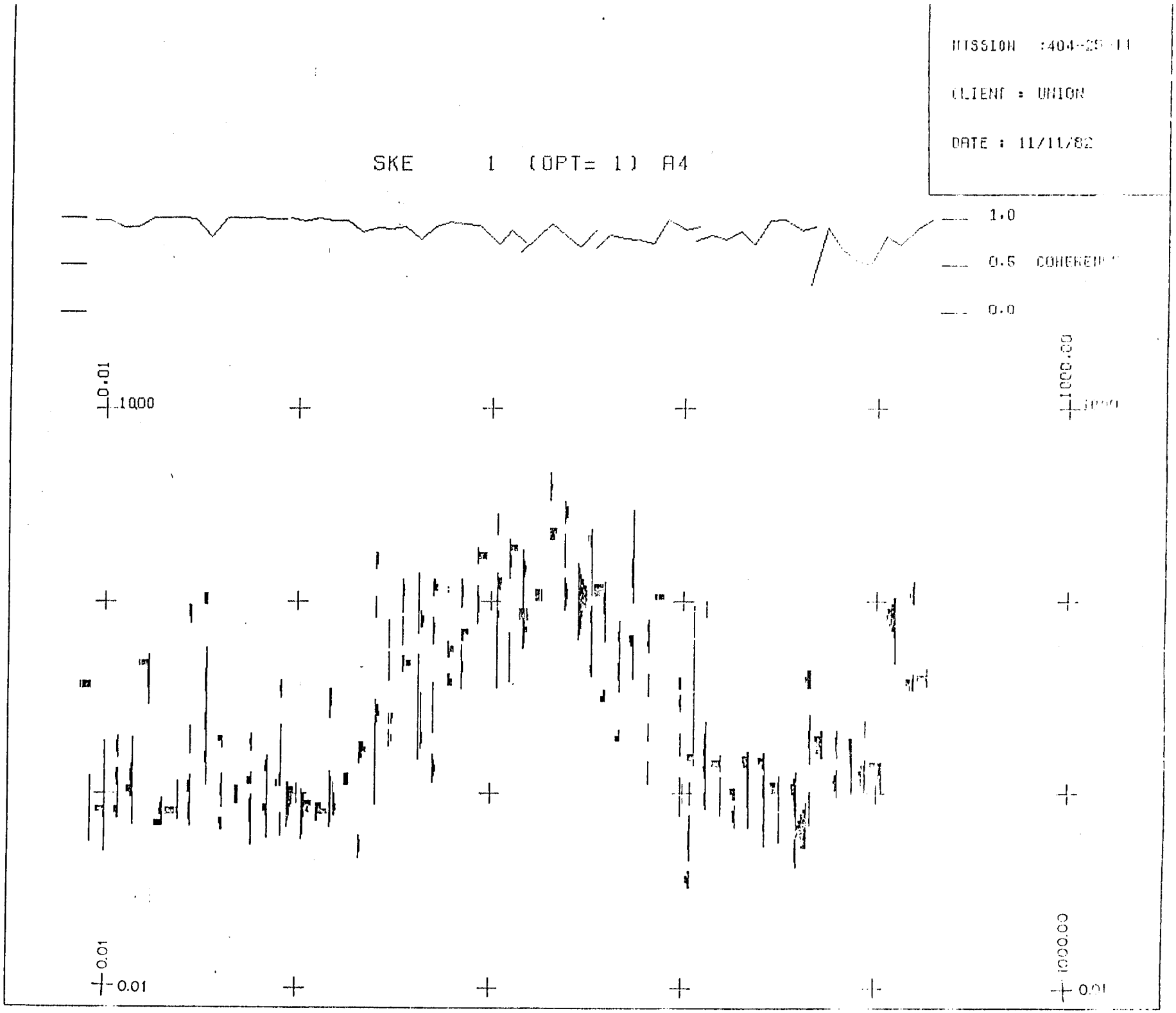

MISSION :404-25-11
CLIENT : UNION
DATE : 16/11/82
PHA XY 1 0130 0130 0130 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

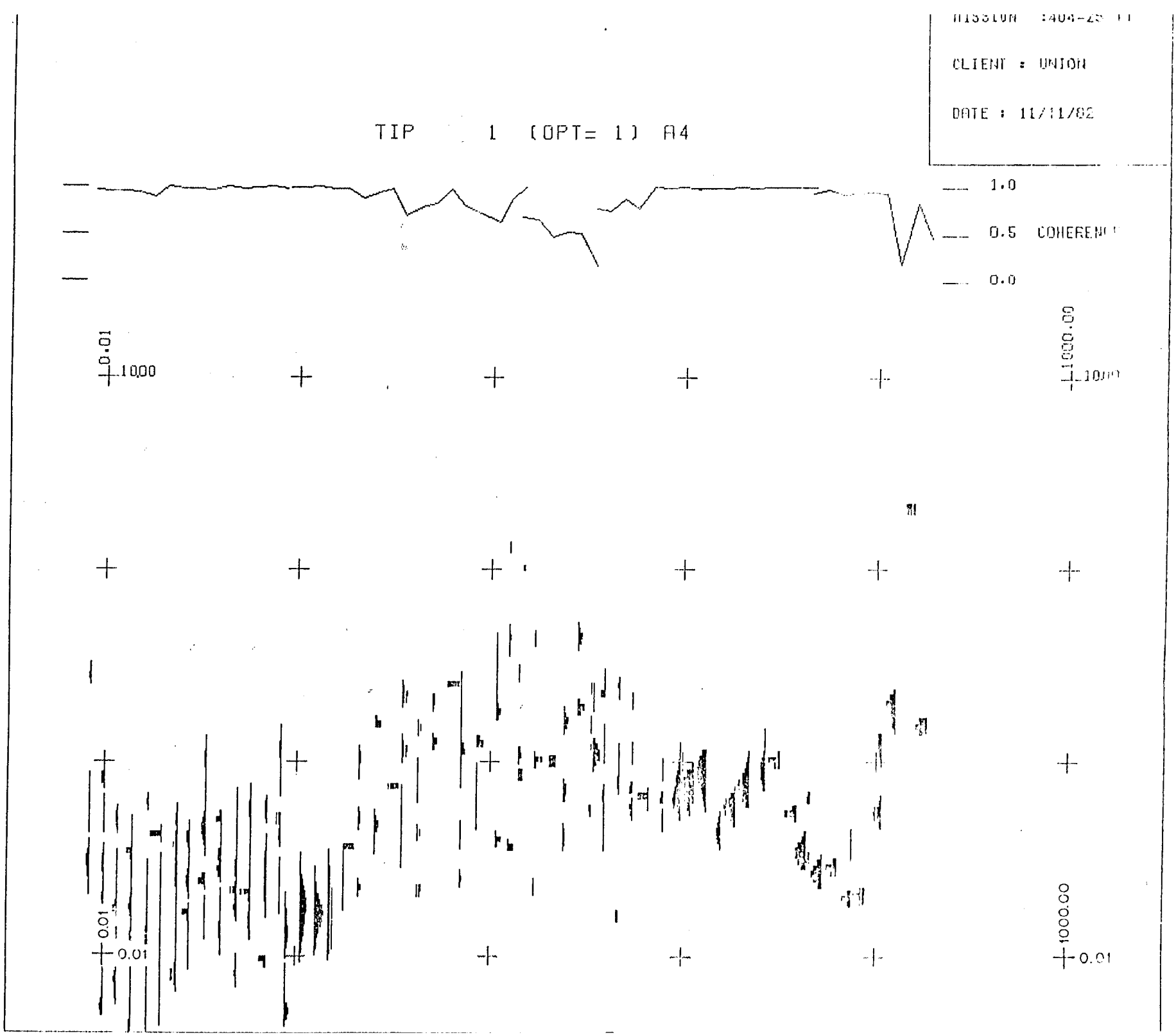

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO YX 1 0080 0080 0080 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
0.01
1.00
PERIODES
1000.00
1.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
PHA YX 1 0080 0080 0080 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO XY 1 0080 0080 0080 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
0.01
1.00
PERIODES
1000.00
1.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
PHA XY 1 0080 0080 0080 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/82
SKE 1 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
1000.00
0.01
1000.00

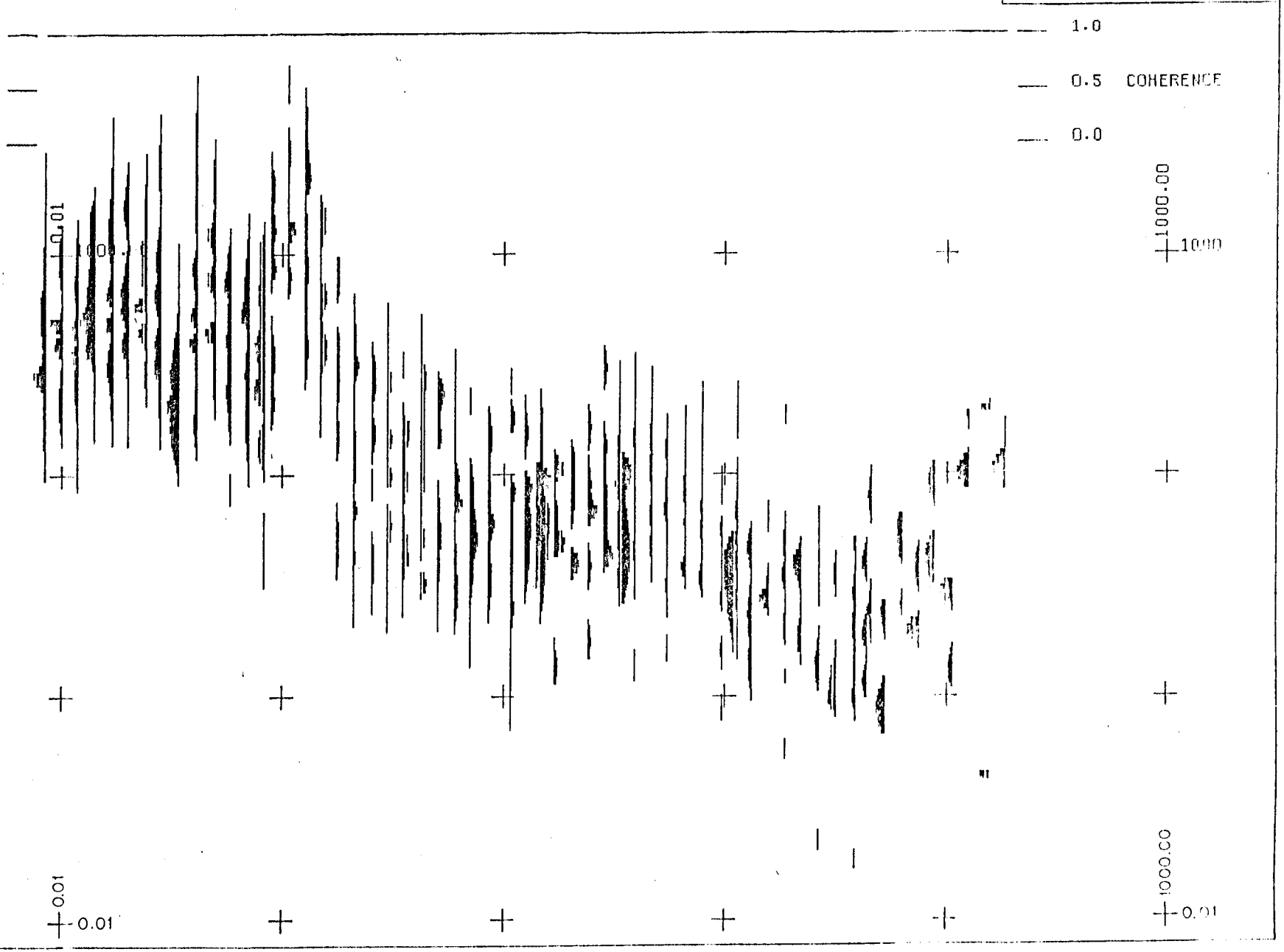

MISSION :404-25 11
CLIENT : UNION
DATE : 11/11/82
TIP 1 (OPT= 1) A4
1.0
0.5 COHERENCE
0.0
0.01
10.00
1000.00
10.00
0.01
1000.00
0.01
0.01

MISSION :404-25-11

CLIENT : UNION

DATE : 16/11/82

ELL 1 0130 0130 0130 (OPT= 1) A4

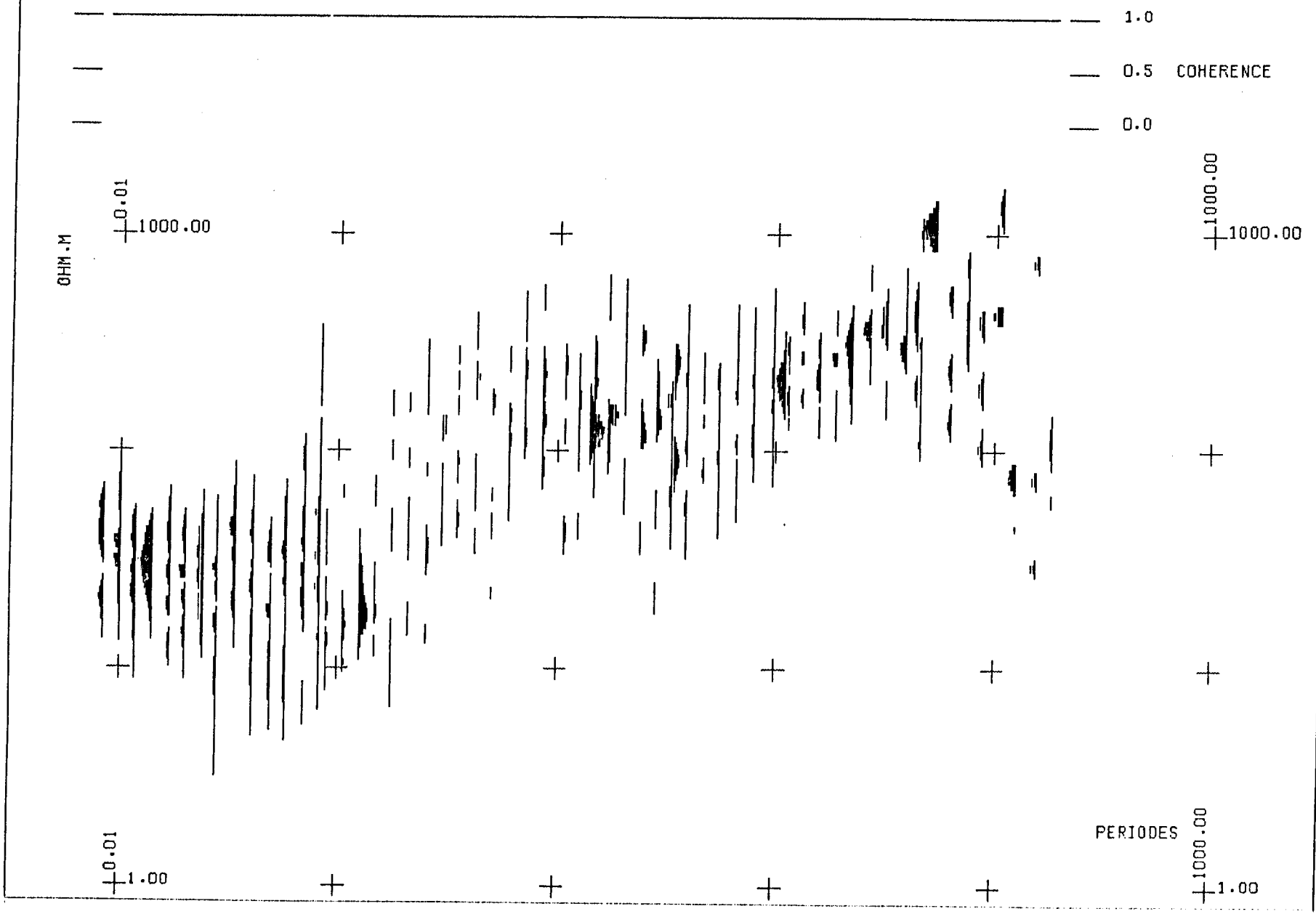


MISSION Z404-25-11

CLIENT : UNION

DATE : 17/11/82

ELL*100 1 0080 0080 0080 (OPT= 1) A4

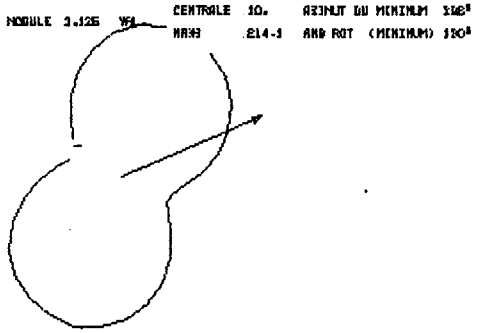


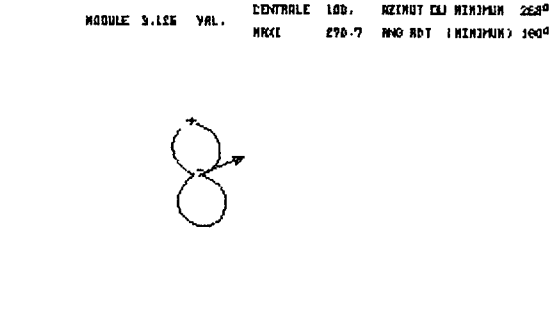
STATION A4
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 75DR
SKEW = 0.042
TIPPER = 0.274
COMBINAISON 1

MISSION : 404-25-11
CLIENT : UNION
DATE : 11/11/82

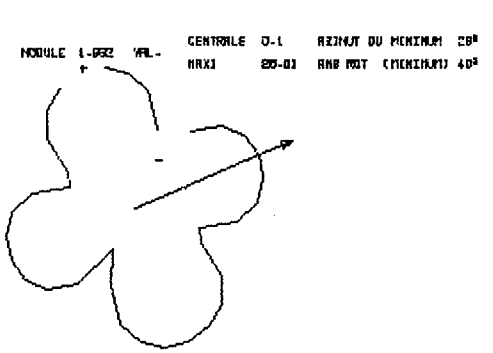
SKEW = 0.156
TIPPER = 0.279
COMBINAISON 2

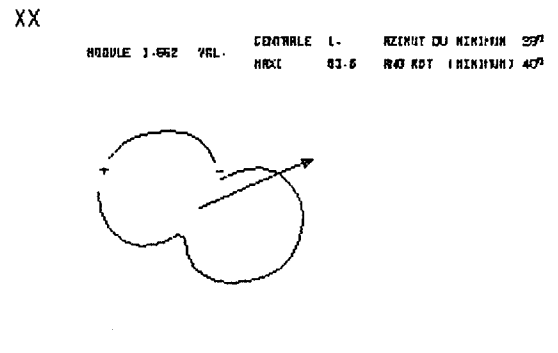
XY



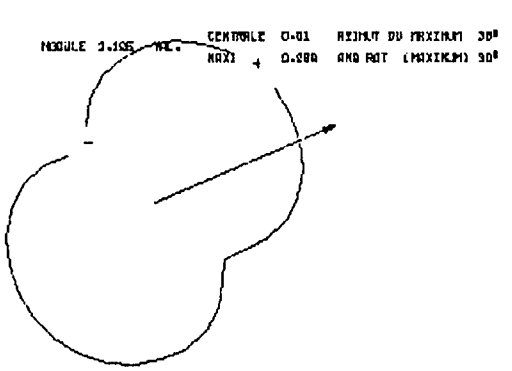



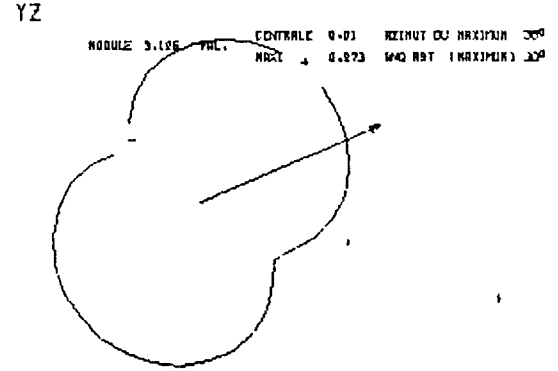

XX




YZ



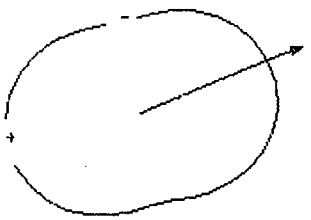
STATION H4
DOMAINE NF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 75DR
SKEW = 0.088
TIPPER = 0.128
COMBINAISON 1

MISSION : 404-85-11
CLIENT : UNION
DATE : 11/11/82

SKEW = 0.126
TIPPER = 0.124
COMBINAISON 2

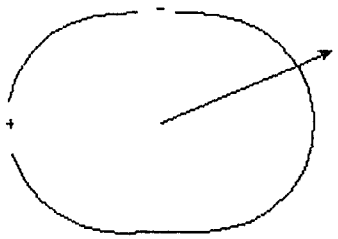
XY

MODULE 5.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 548°
MAXI 154.0 ANG ROT (MINIMUM) 80°



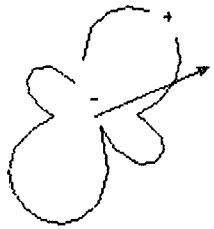
XY

MODULE 5.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 268°
MAXI 219.1 ANG ROT (MINIMUM) 70°



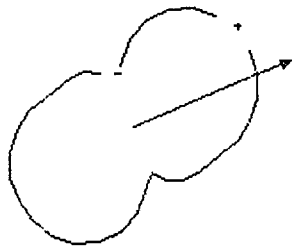
XX

MODULE 1.692 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 338°
MAXI 10.08 ANG ROT (MINIMUM) 80°



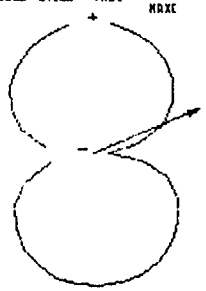
XX

MODULE 1.692 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 338°
MAXI 24.11 ANG ROT (MINIMUM) 80°



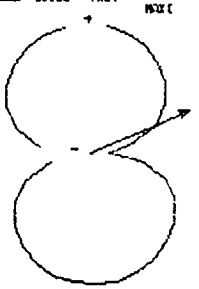
YZ

MODULE 5.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 358°
MAXI 0.198 ANG ROT (MAXIMUM) 70°



YZ

MODULE 5.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 358°
MAXI 0.194 ANG ROT (MAXIMUM) 70°



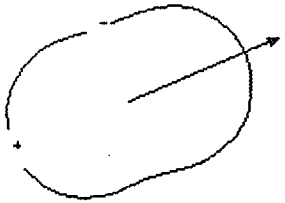
STATION H4
DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 75gr
SKEW = 0.074
TIPPER = 0.092
COMBINAISON 1

MISSION : 404-23-LL
CLIENT : UNICOR
DATE : 11/11/82

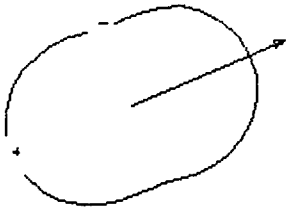
SKEW = 0.074
TIPPER = 0.088
COMBINAISON 2

XY

MODULE 3.125 VAL. CENTRALE LO. AZIMUT DU MINIMUM 338°
MAXI 121.2 ANG ROT (MINIMUM) 80°



MODULE 3.135 VAL. CENTRALE LO. AZIMUT DU MINIMUM 338°
MAXI 129.9 ANG ROT (MINIMUM) 60°



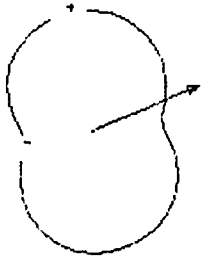
XX

MODULE 1.952 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 339°
MAXI 0.11 ANG ROT (MINIMUM) 100°

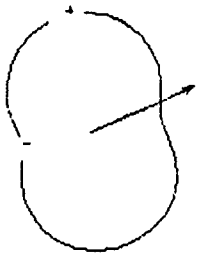
MODULE 1.952 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 328°
MAXI 0.48 ANG ROT (MINIMUM) 100°

YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 348°
MAXI 0.106 ANG ROT (MAXIMUM) 80°



MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 348°
MAXI 0.100 ANG ROT (MAXIMUM) 80°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 5

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/27 | 2 | A | 1 | A | 3 | A |
| | 5 | B | 4 | B | 3 | B |

| | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| FIELD ARRAY | Ex | 235 | 211.5 = 168°5W |
| | Ey | 135 | 121.5 = 121°5E |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 31°5E | 0 | 211.5 = 31.5E | XY | YX |
| | 61°5E (HF) | 150 | 61.5E | XY | YX |
| STRIKE from Hz | 61°5E | | | | |

## COMMENTS

### FIELD

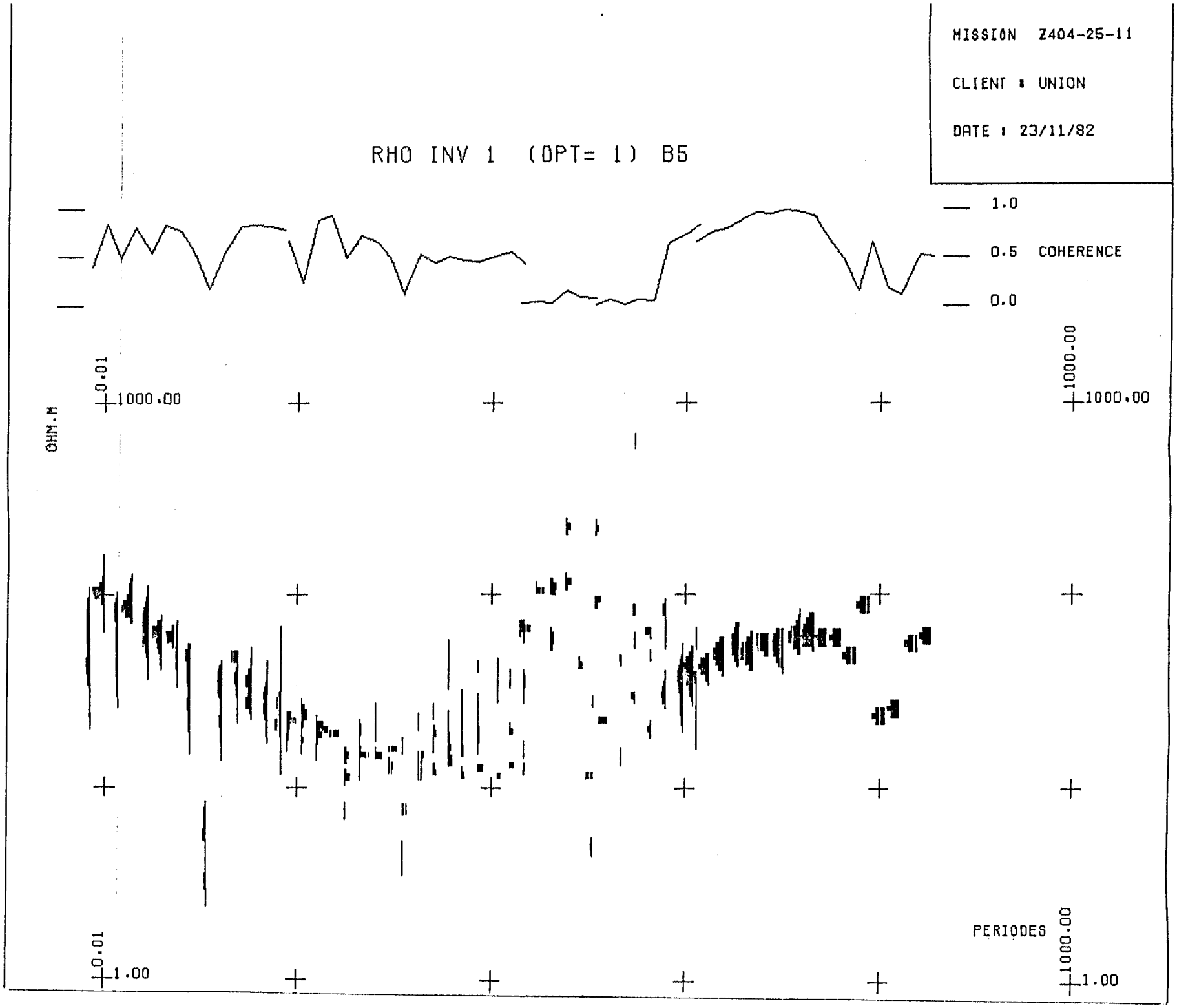
In a forest
melting snow on ground

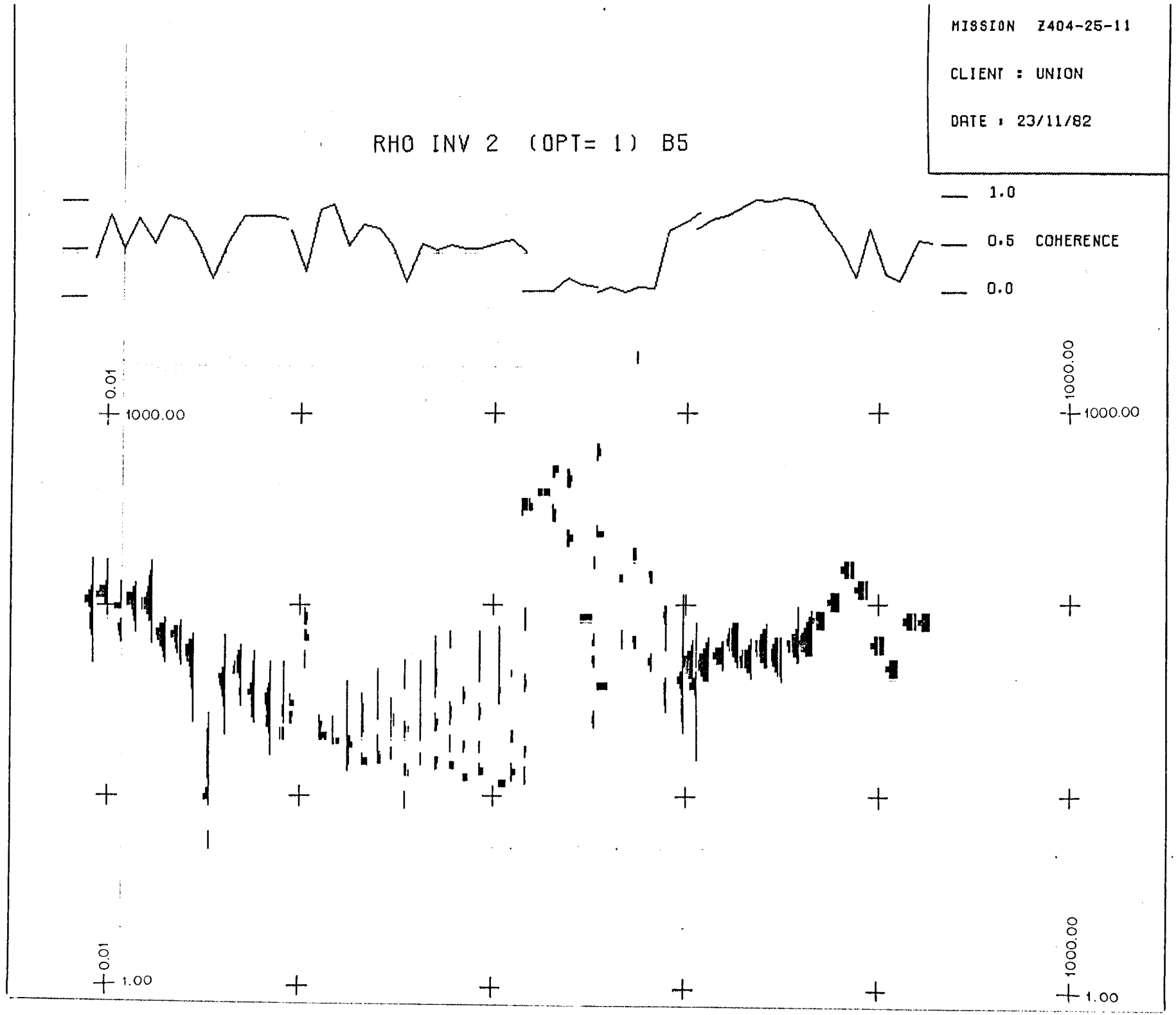
### PROCESSING

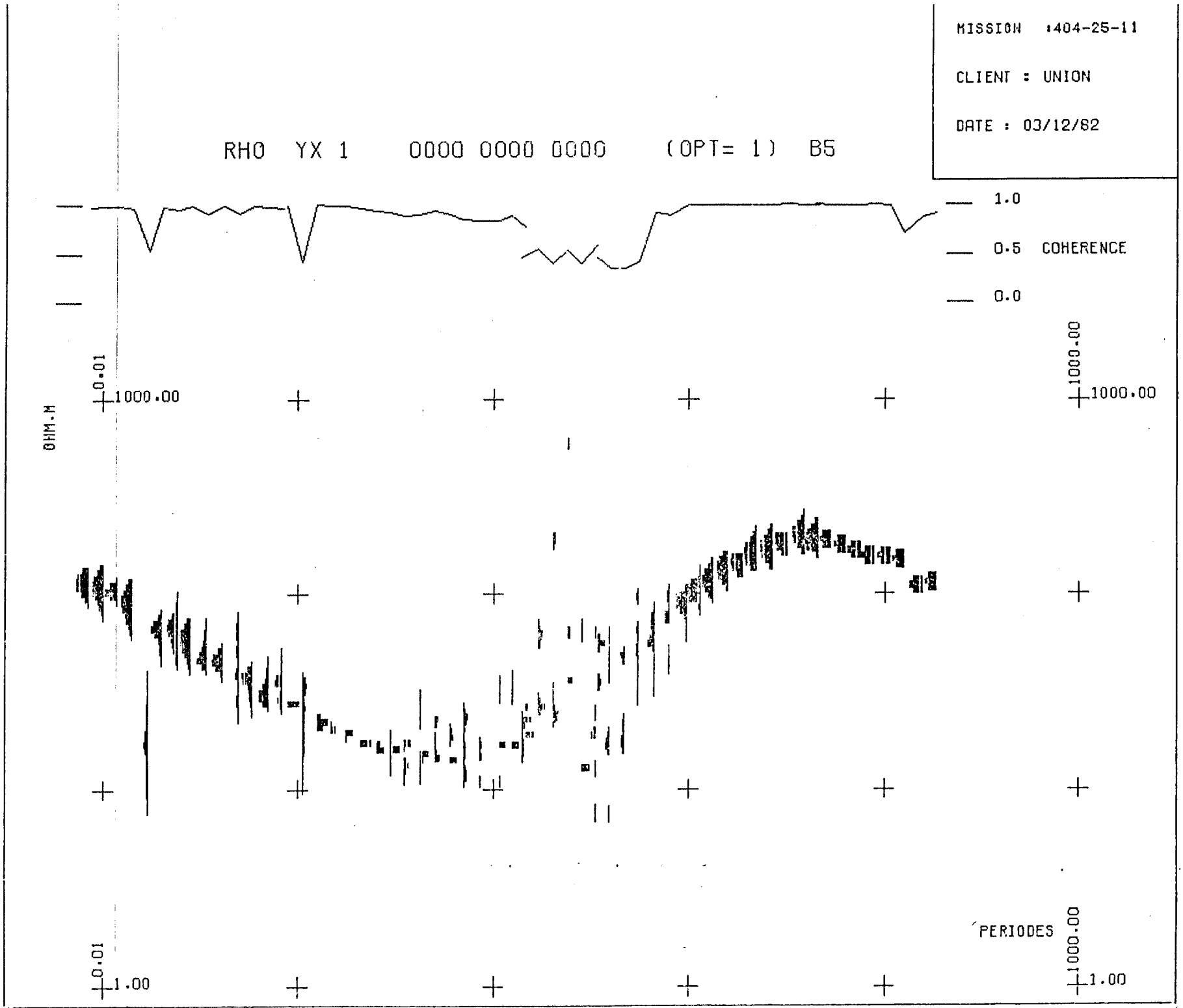
Fair

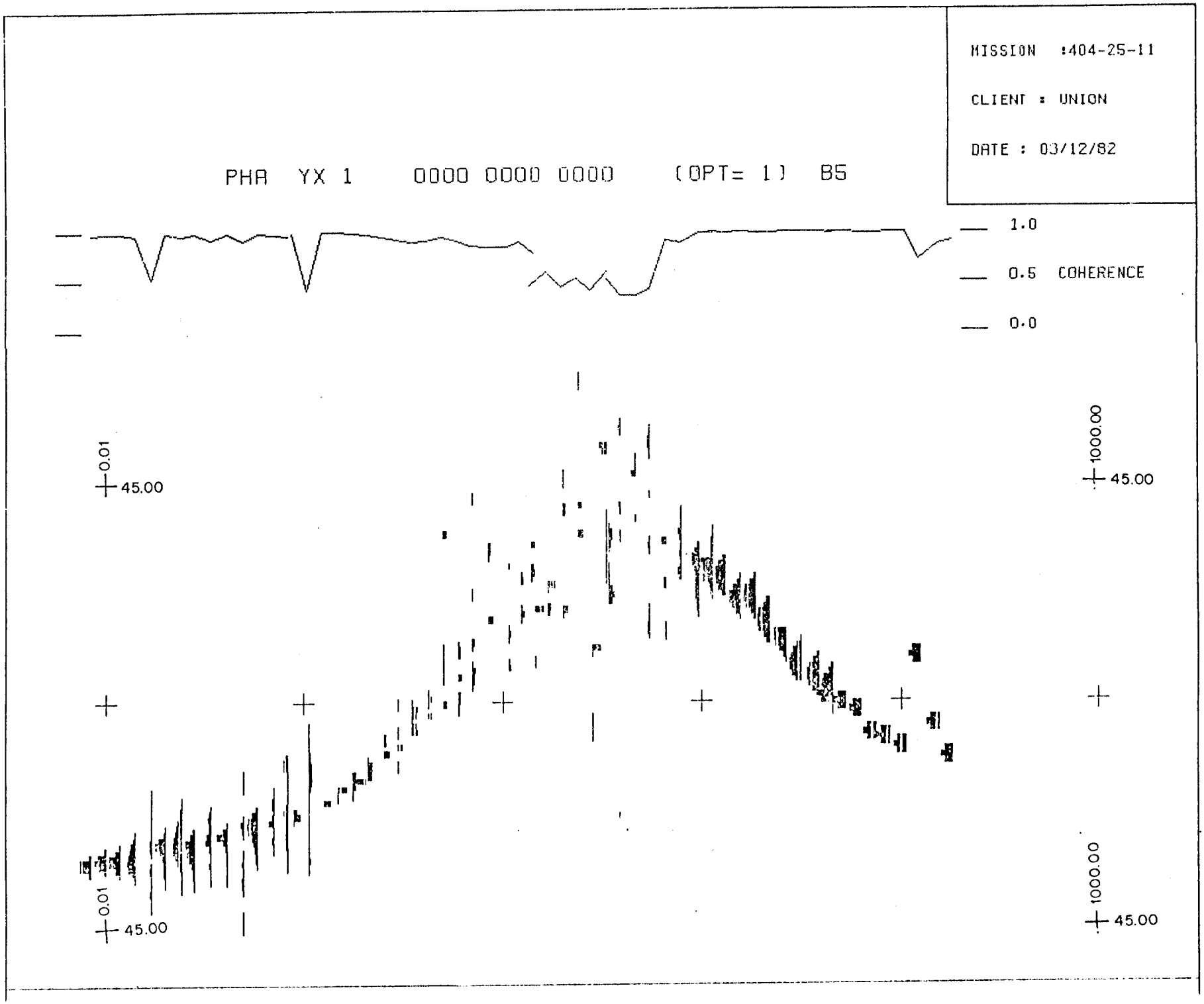
HF: ρE # ρH

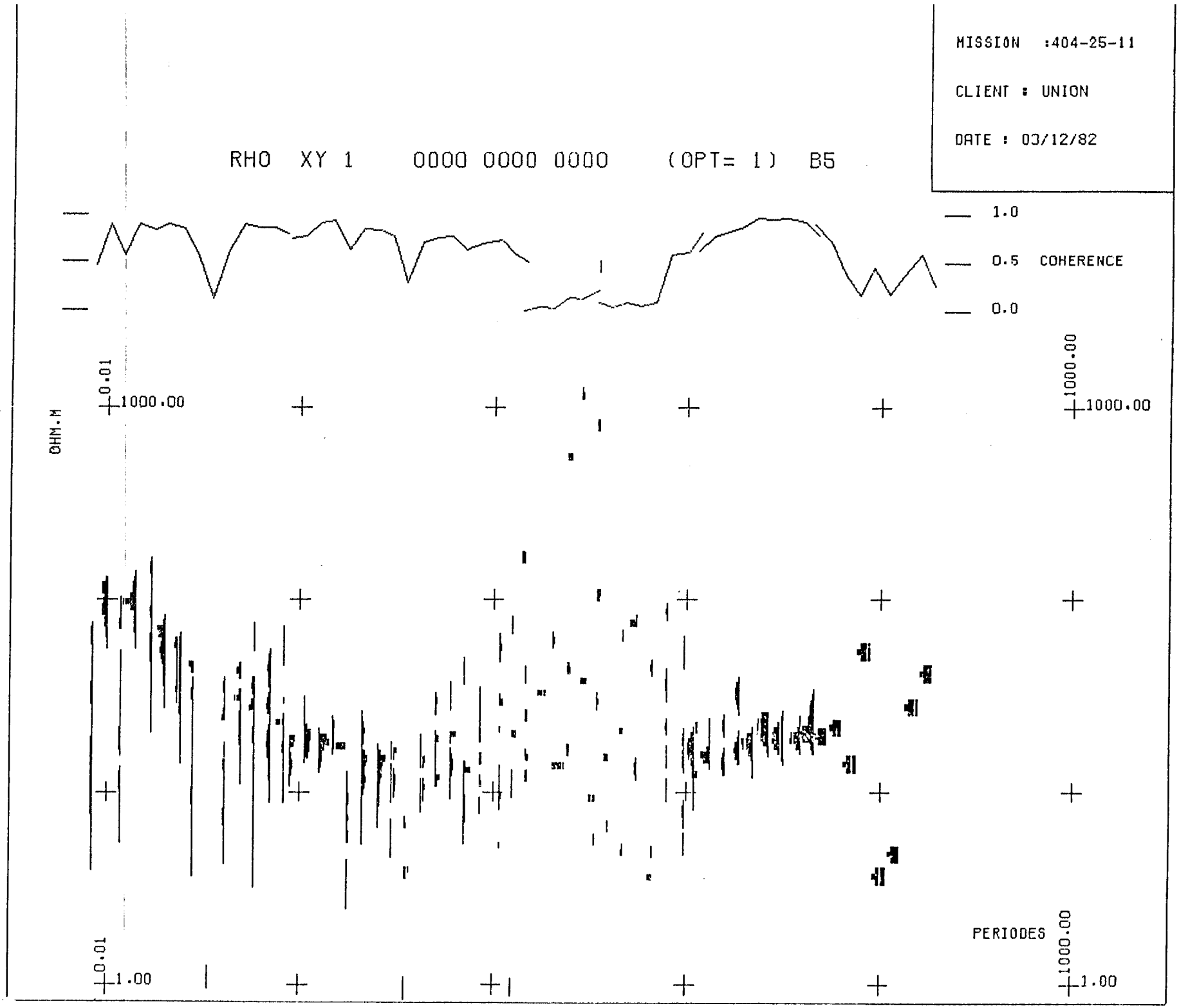
LF: ρE < ρH

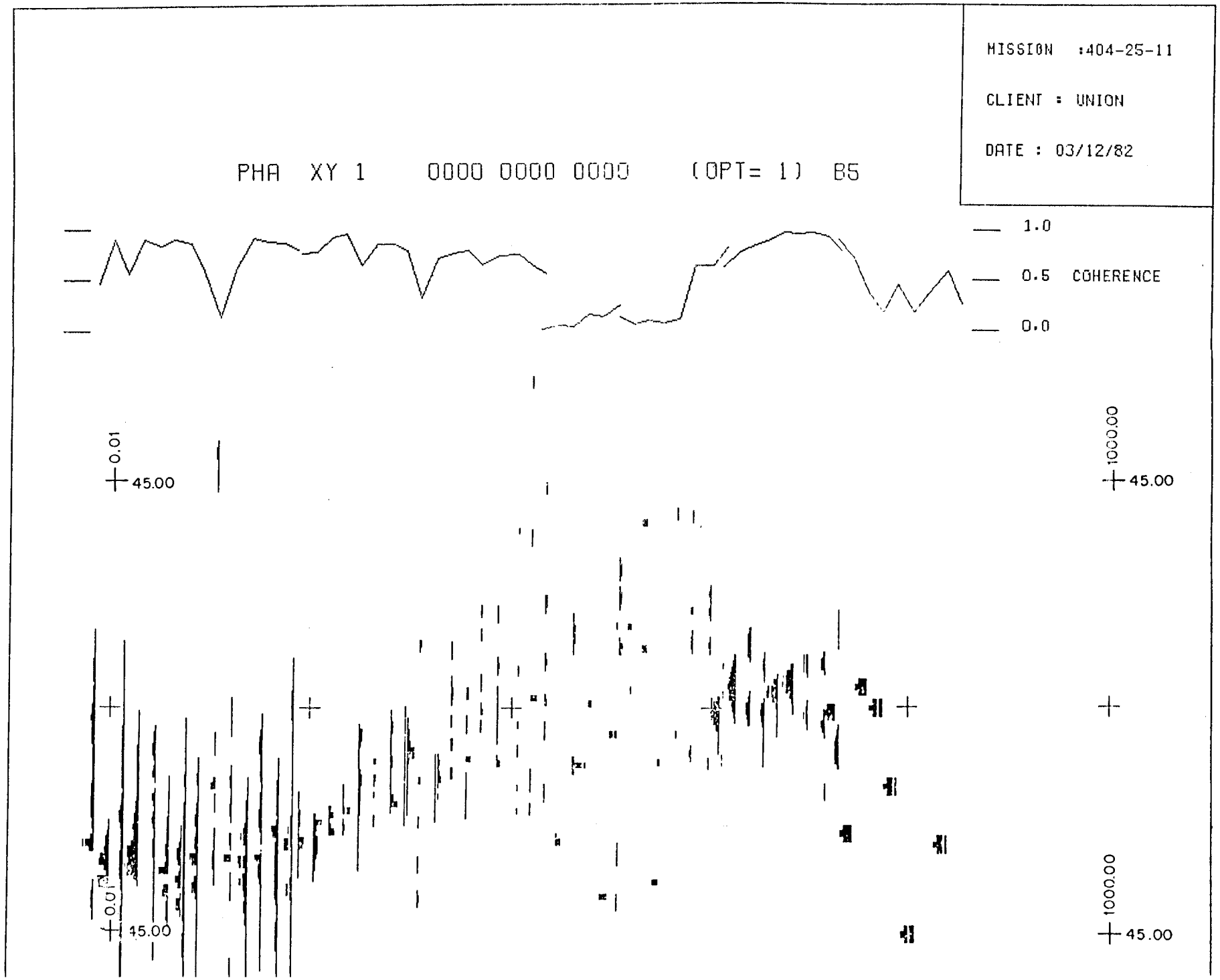

MISSION Z404-25-11
CLIENT : UNION
DATE : 23/11/82
RHO INV 1 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
0.01
1.00
PERIODES
1000.00
1.00

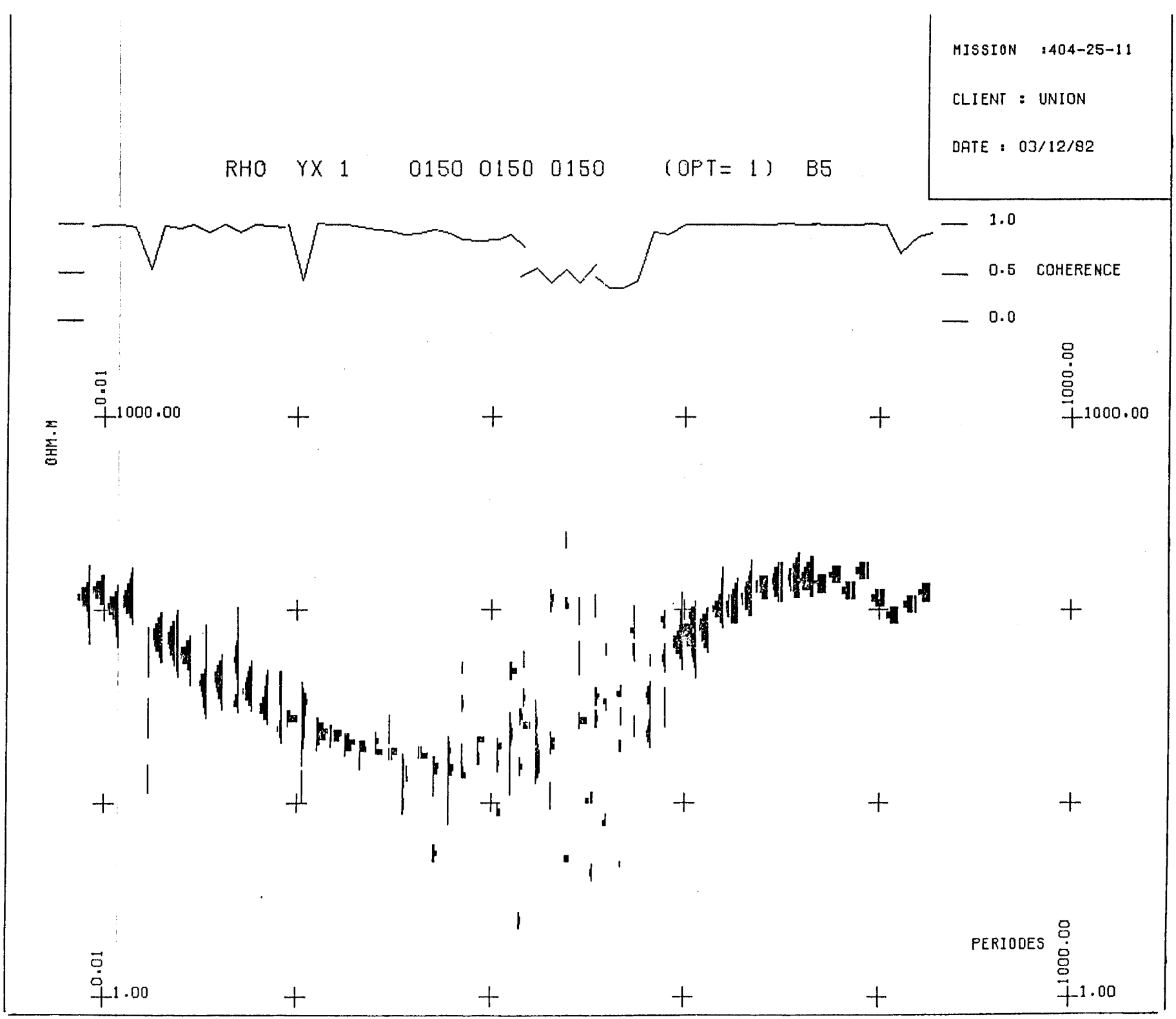

MISSION Z404-25-11
CLIENT : UNION
DATE : 23/11/82
RHO INV 2 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

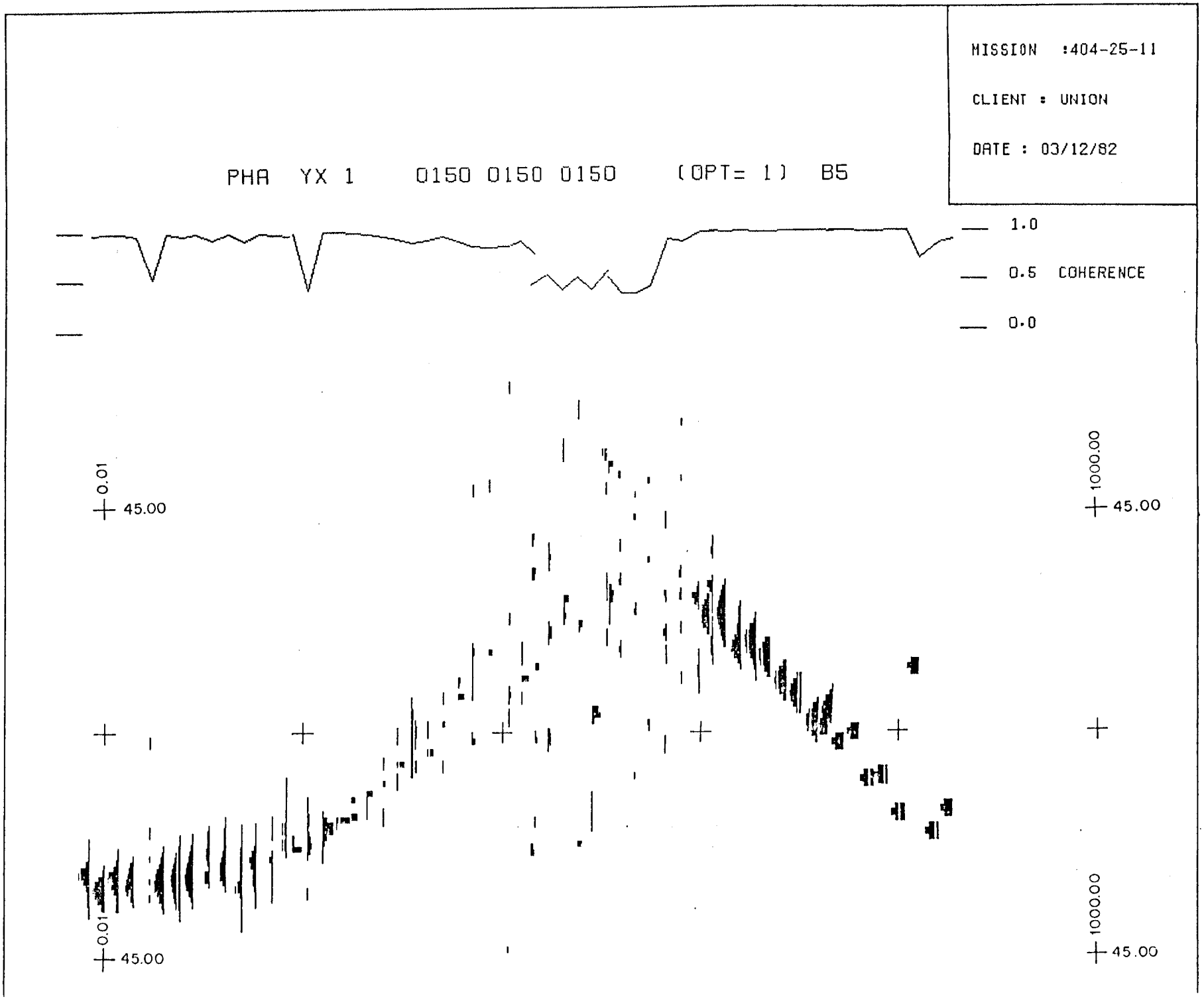

MISSION :404-25-11
CLIENT : UNION
DATE : 03/12/82
RHO YX 1 0000 0000 0000 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
PERIODES
0.01
1.00
1000.00
1.00

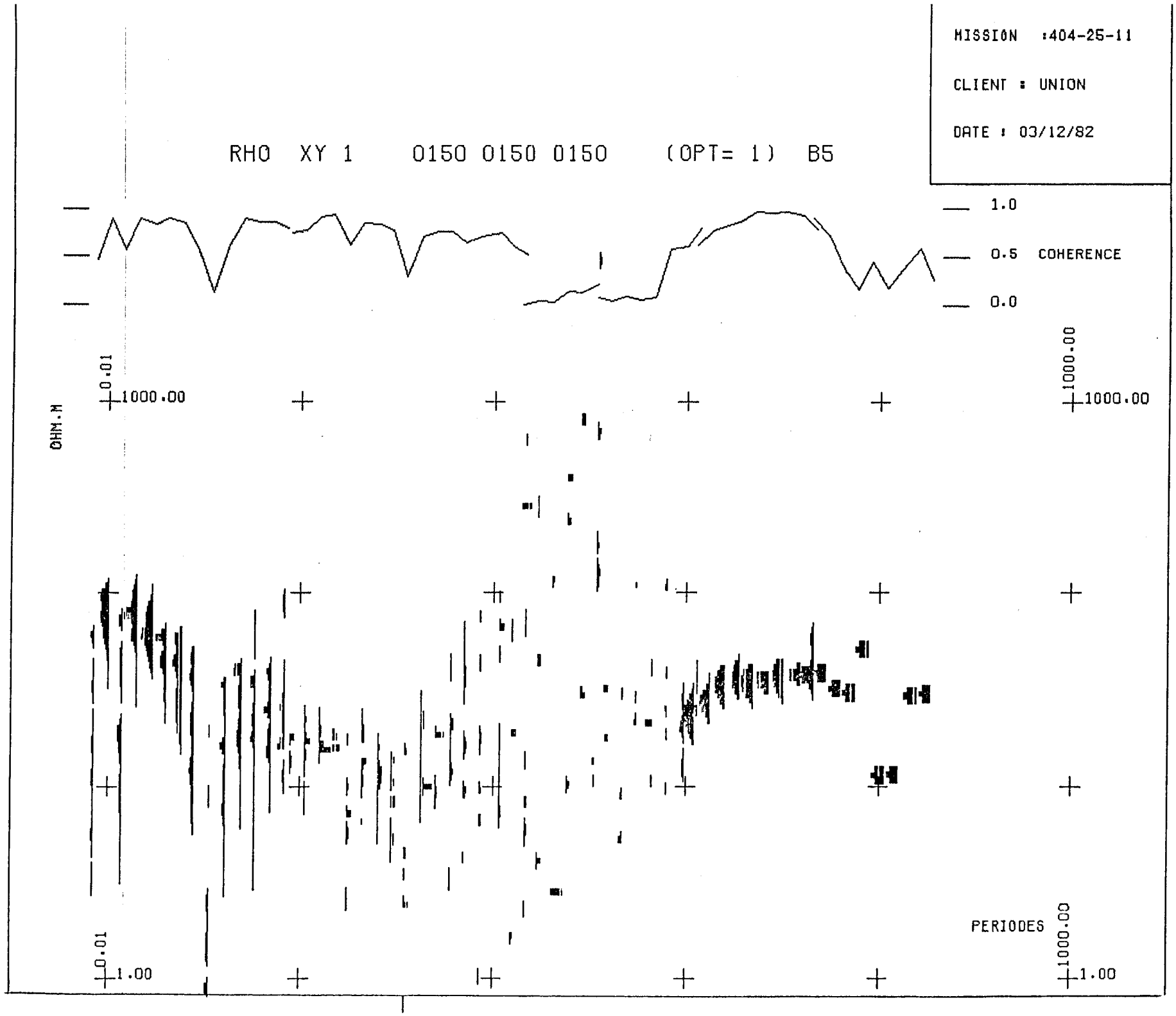

MISSION :404-25-11
CLIENT : UNION
DATE : 03/12/82
PHA YX 1 0000 0000 0000 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

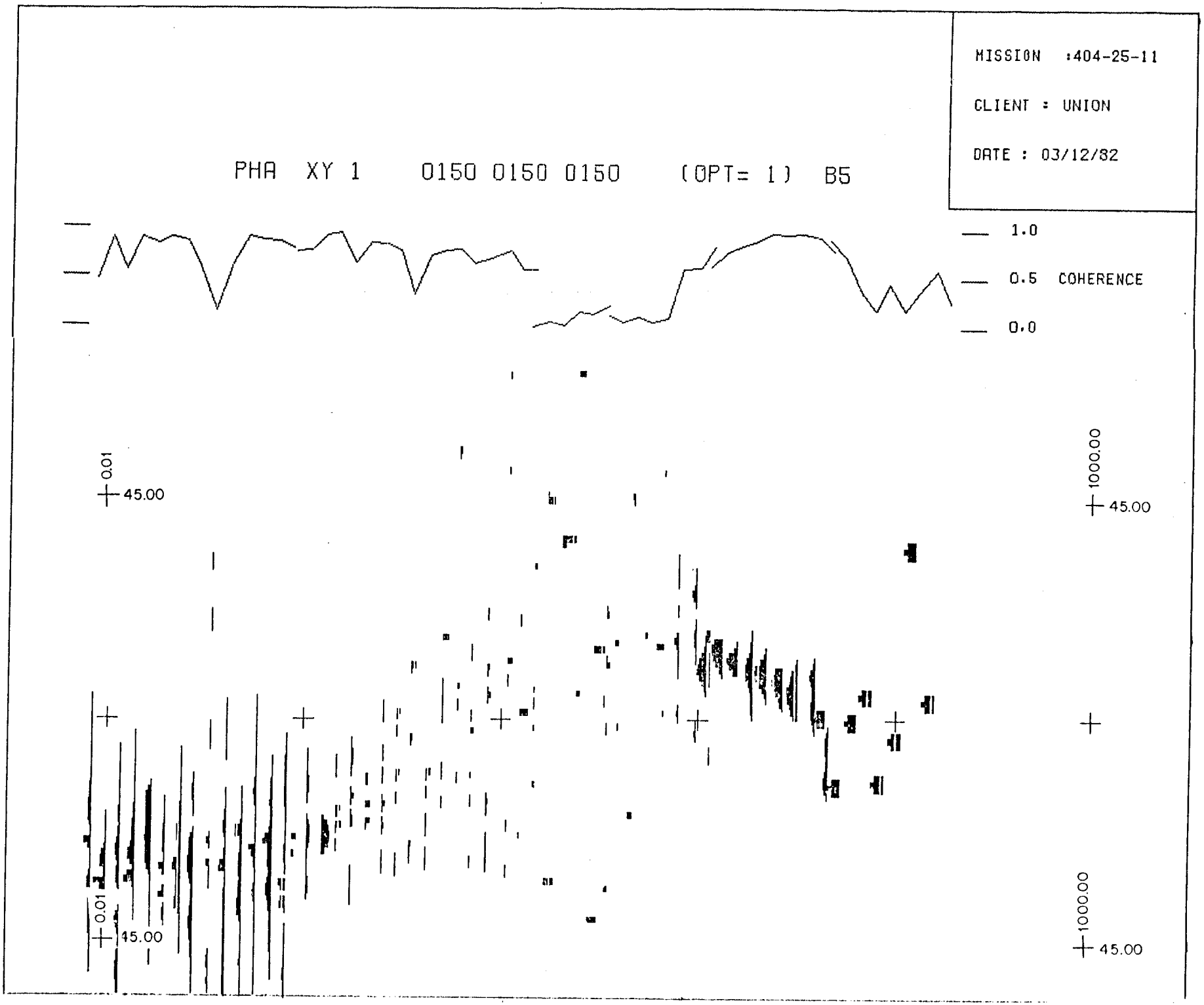

MISSION :404-25-11
CLIENT : UNION
DATE : 03/12/82
RHO XY 1 0000 0000 0000 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
0.01
1.00
PERIODES
1000.00
1.00

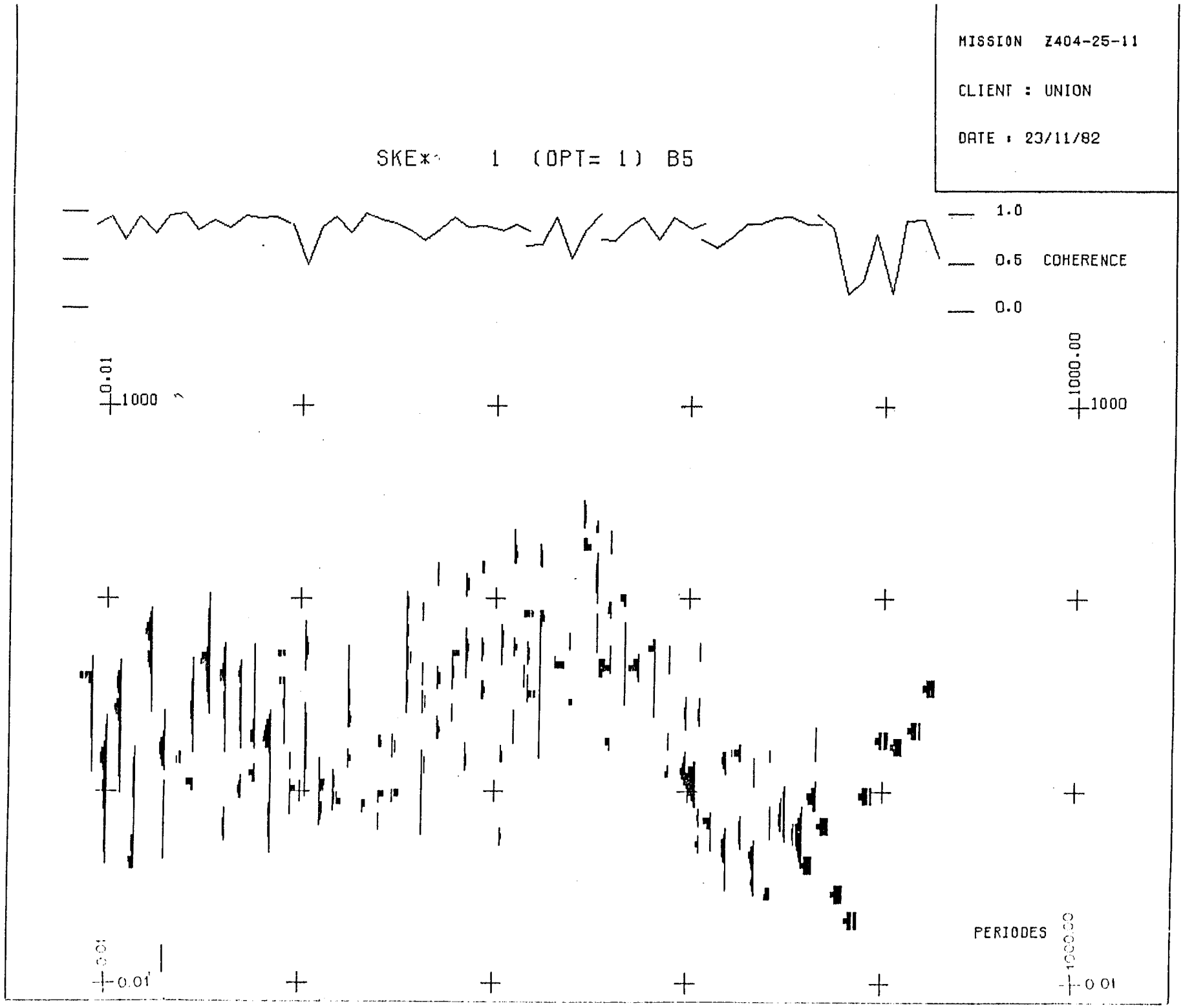

MISSION :404-25-11
CLIENT : UNION
DATE : 03/12/82
PHA XY 1 0000 0000 0000 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

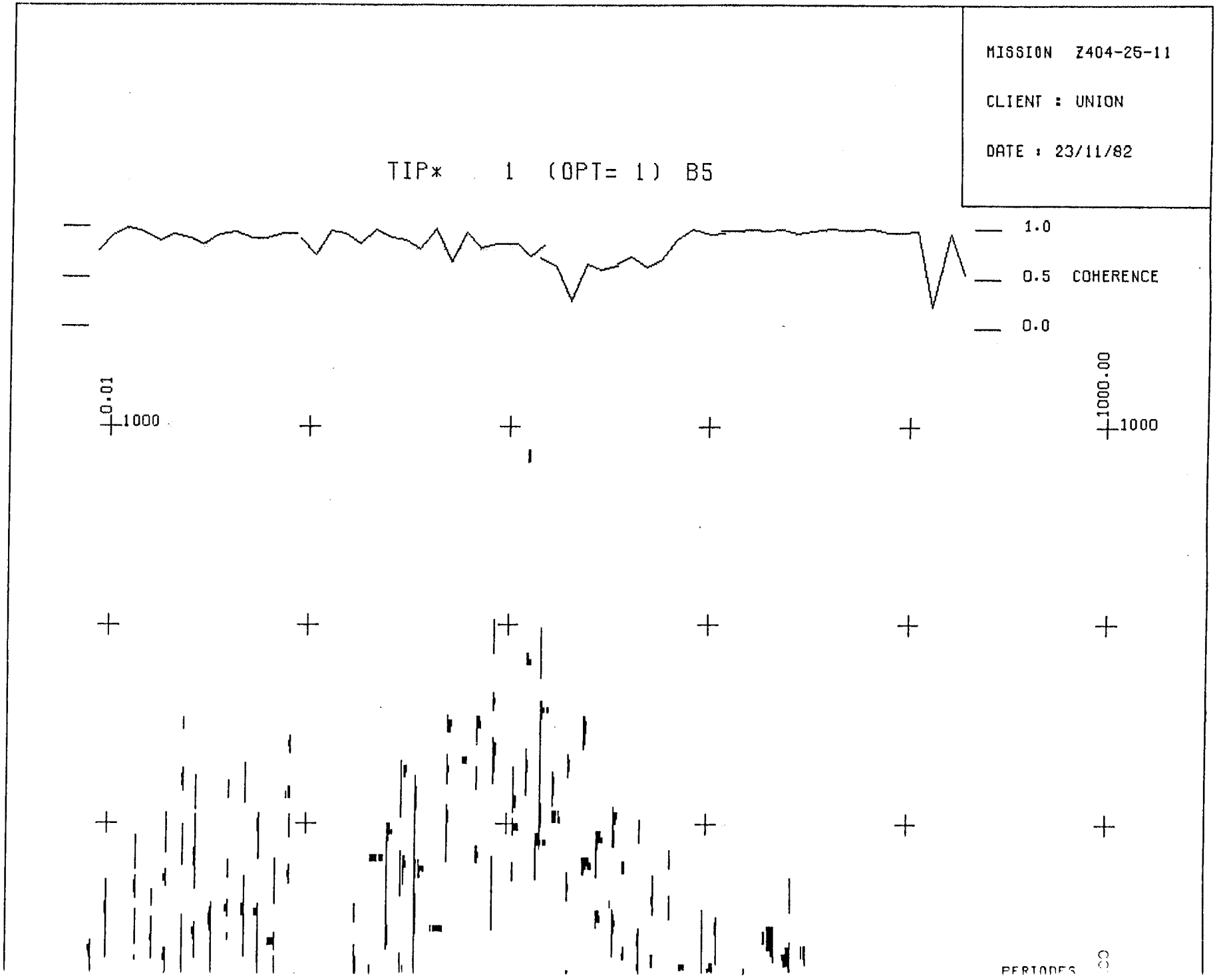

MISSION :404-25-11
CLIENT : UNION
DATE : 03/12/82
RHO YX 1 0150 0150 0150 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
0.01
1.00
PERIODES
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 03/12/82
PHA YX 1 0150 0150 0150 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 03/12/82
RHO XY 1 0150 0150 0150 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
0.01
1.00
PERIODES
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 03/12/82
PHA XY 1 0150 0150 0150 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 23/11/82
SKE* 1 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
1000
PERIODES
0.01
1000.00
0.01

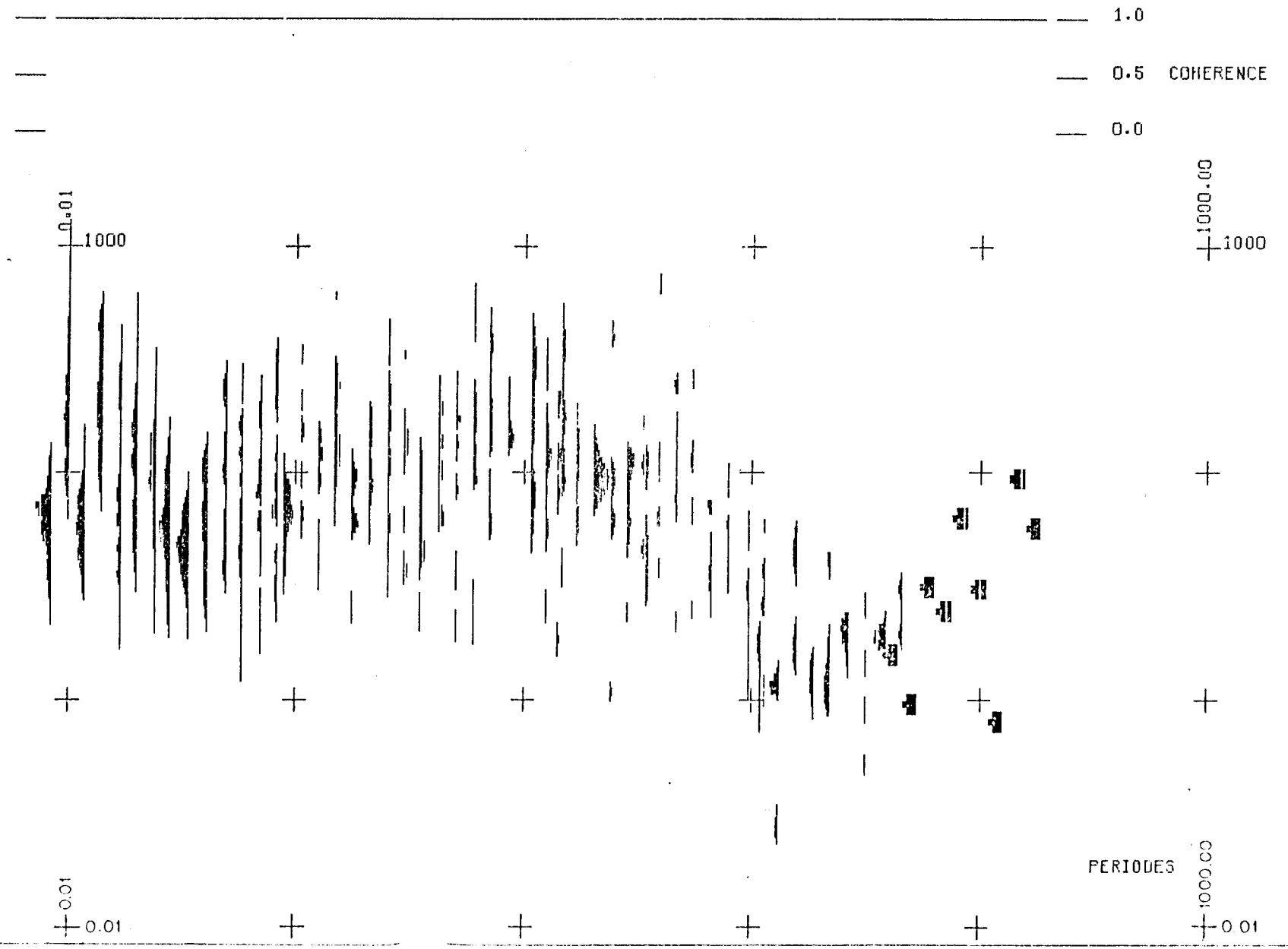

MISSION Z404-25-11
CLIENT : UNION
DATE : 23/11/82
TIP* 1 (OPT= 1) B5
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
1000
PERIODES

MISSION :404-25-11

CLIENT : UNION

DATE : 03/12/82

ELL* 1 0000 0000 0000 (OPT= 1) B5

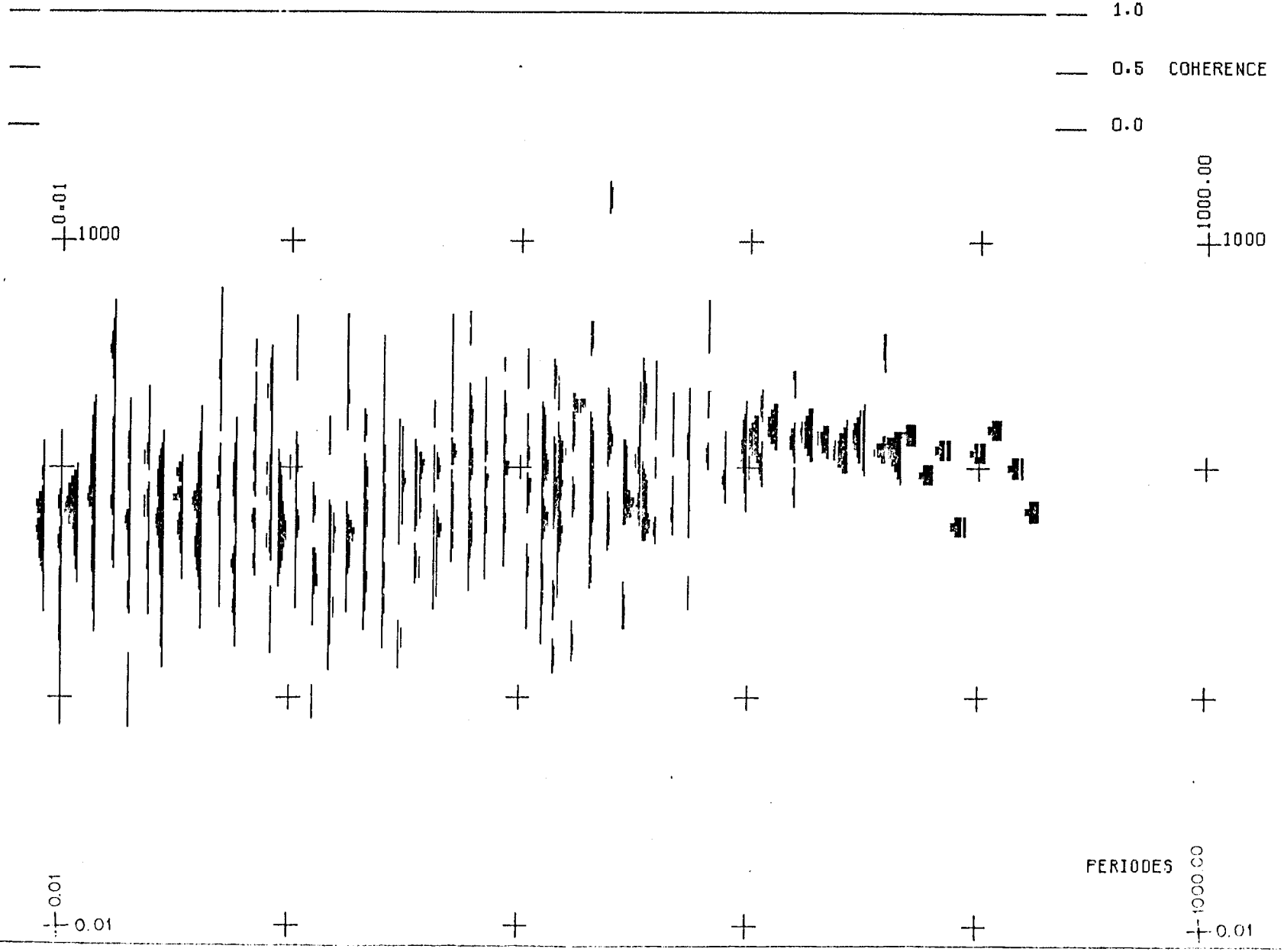


MISSION :404-25-11

CLIENT : UNION

DATE : 03/12/82

ELL* 1 0150 0150 0150 (OPT= 1) B5

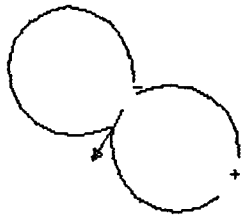


STATION B5
DOMAINE BF
DECOUPAGE EN 4
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 235DM
SKEW = 0.038
TIPPER = 0.124
COMBINAISON 1

MISSION : 2404-25-11
CLIENT : UNION
DATE : 25/11/92

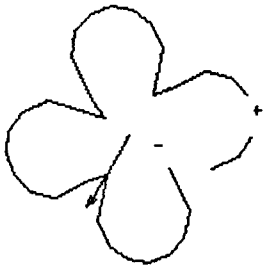
XY

MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 51°
MAXI 127.7 RNG ROT (MINIMUM) 180°



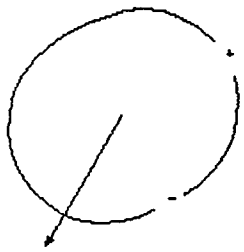
XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 121°
MAXI 13.21 RNG ROT (MINIMUM) 80°



YZ

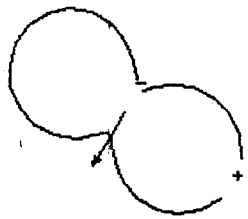
MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 61°
MAXI 0.106 RNG ROT (MAXIMUM) 150°



SKEW = 0.032
TIPPER = 0.121
COMBINAISON 2

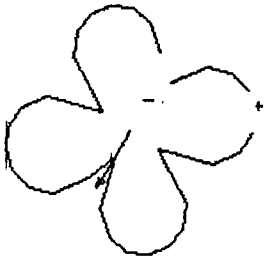
XY

MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 31°
MAXI 127.7 RNG ROT (MINIMUM) 180°



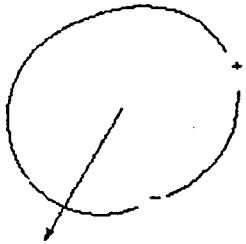
XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 31°
MAXI 13.32 RNG ROT (MINIMUM) 180°



YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 71°
MAXI 0.104 RNG ROT (MAXIMUM) 140°



STATION 05
DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 235DE
SKEW = 0.129
TIPPER = 0.026
COMBINAISON 1

MISSION : 2404-25-11
CLIENT : UNION
DATE : 23/11/82

SKEW = 0.290
TIPPER = 0.032
COMBINAISON 2

XY

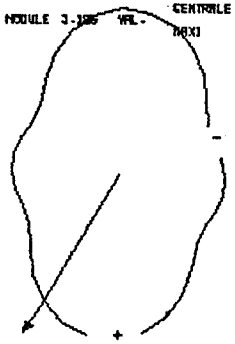
MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 61°
MAXI 40.8 ANG ROT (MINIMUM) 180°

XY

MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 101°
MAXI 139.2 ANG ROT (MINIMUM) 20°

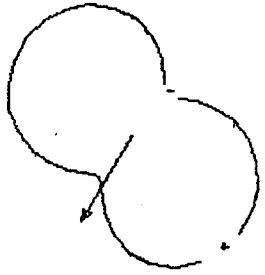
XX

MODULE 3.126 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 71°
MAXI 2.30 ANG ROT (MINIMUM) 140°



XX

MODULE 3.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 41°
MAXI 28.74 ANG ROT (MINIMUM) 170°

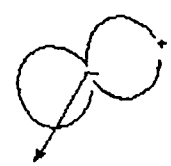


YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 71°
MAXI 0.031 ANG ROT (MAXIMUM) 140°

YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 71°
MAXI 0.043 ANG ROT (MAXIMUM) 140°



STATION 65
DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 235DM
SKEW = 0.127
TIPPER = 0.037
COMBINAISON 1

MISSION : 2404-25-11
CLIENT : UNION
DATE : 23/11/82

SKEW = 0.094
TIPPER = 0.041
COMBINAISON 2

XY

MODULE 3.136 VAL. CENTRALE 10. AZIMUT DU MINIMUM 61°
MAXI 42.4 ANG ROT (MINIMUM) 100°

XY

MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 61°
MAXI 66.4 ANG ROT (MINIMUM) 160°

XX

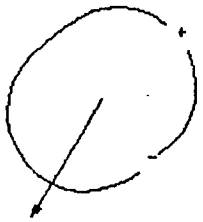
MODULE 1.582 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 61°
MAXI 4.70 ANG ROT (MINIMUM) 150°

XX

MODULE 1.582 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 71°
MAXI 4.81 ANG ROT (MINIMUM) 140°

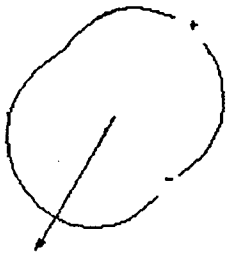
YZ

MODULE 3.196 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 81°
MAXI 0.072 ANG ROT (MAXIMUM) 180°



YZ

MODULE 3.196 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 41°
MAXI 0.098 ANG ROT (MAXIMUM) 170°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 6

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/18 | 33 | A | 32 | A | 34 | A-B |
| | 36 | B | 35 | B | | |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 200 | 180 = 0° |
| | Ey | 100 | 90 = 90°E |

| STRIKE from Exy, Hxy | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| | 0° | 90 | 90 = 90°E | YX | XY |
| STRIKE from Hz | 15°W | | | | |

## COMMENTS

### FIELD

no clouds
light wind
LF: fair signal

### PROCESSING

Fair

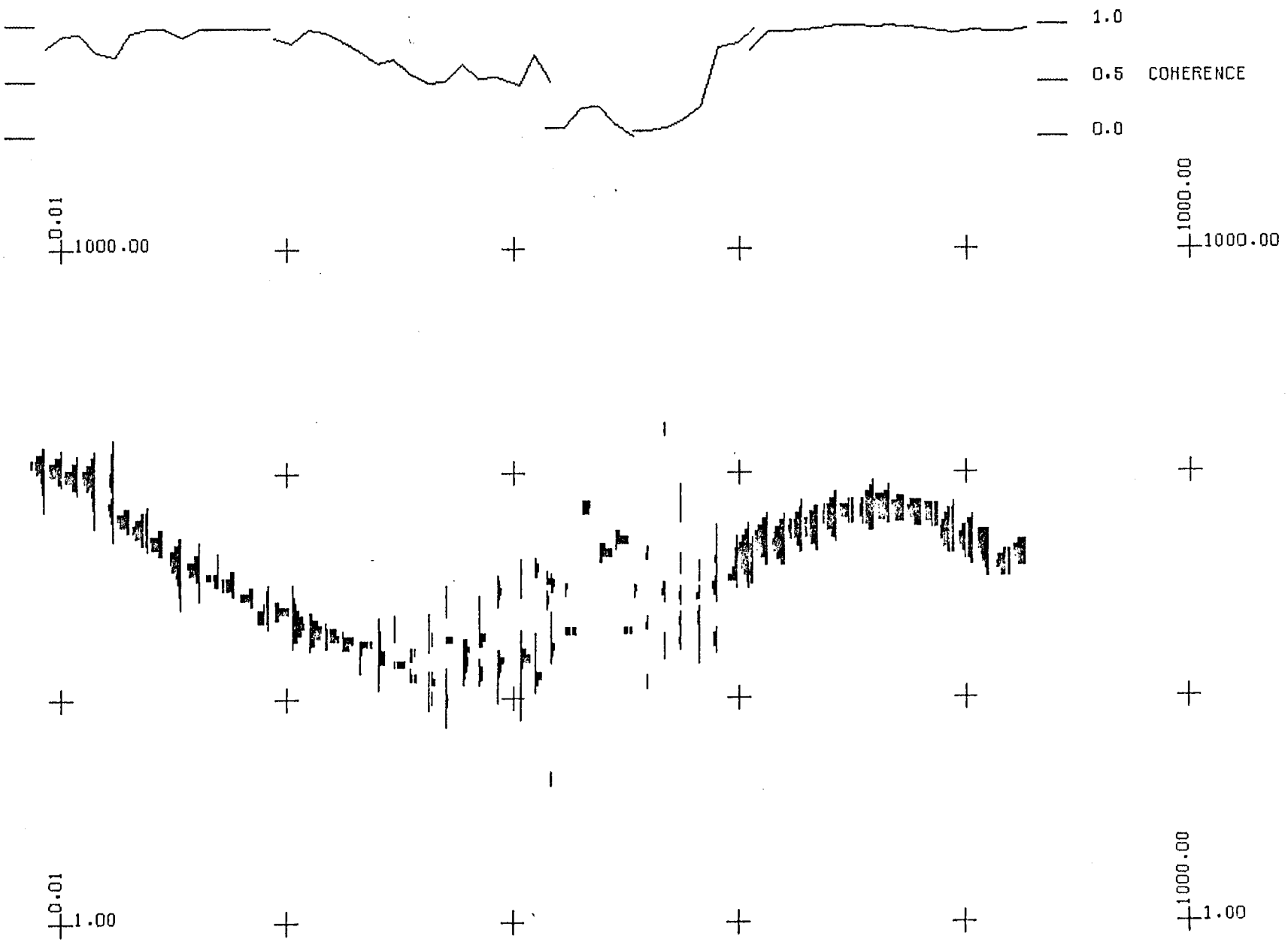
HF: $\rho E < \rho H$
LF: $\rho E > \rho H$

MISSION :404-25-11

CLIENT : UNION

DATE : 09/11/82

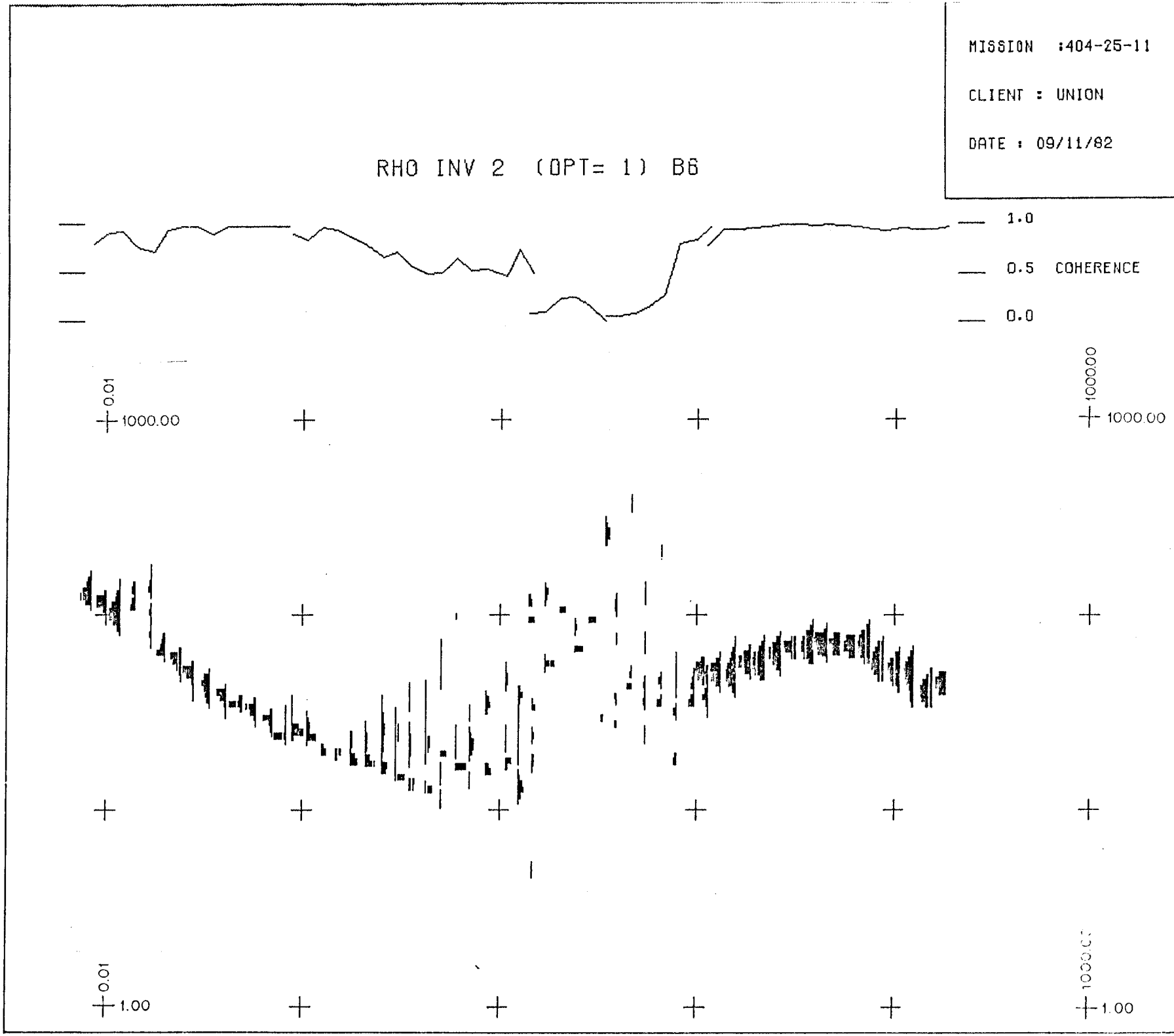
RHO INV 1 (OPT= 1) B6

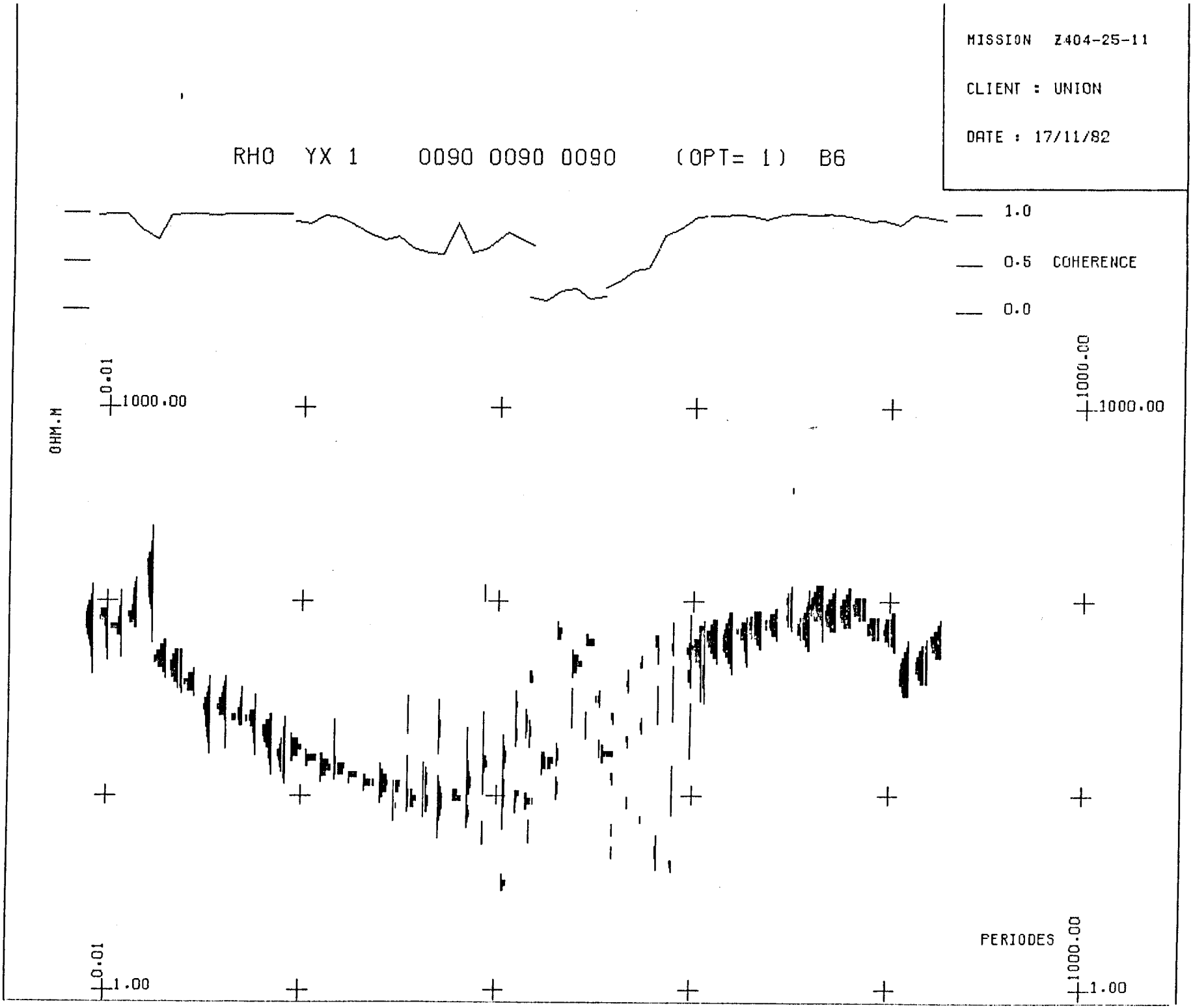


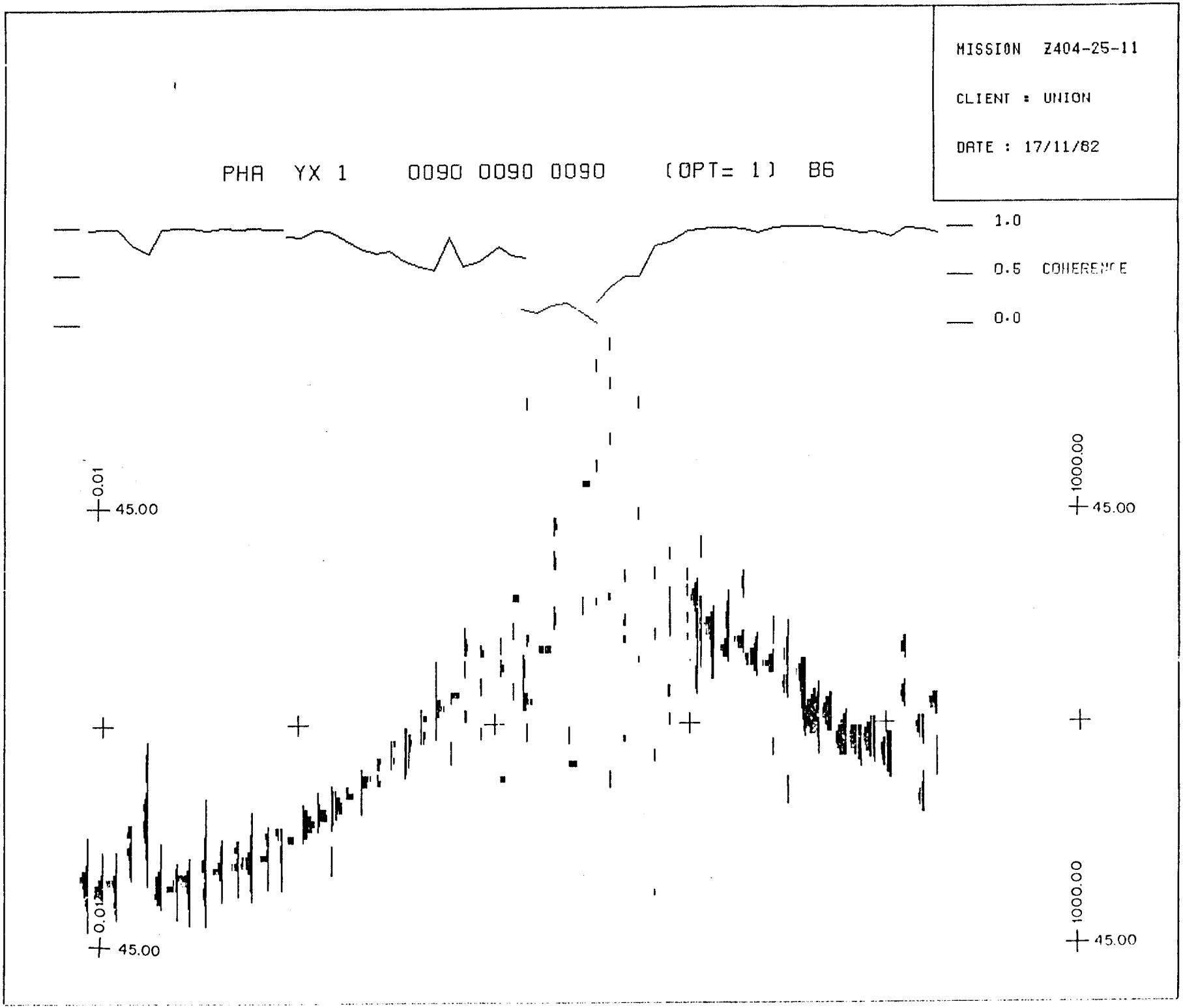
MISSION :404-25-11

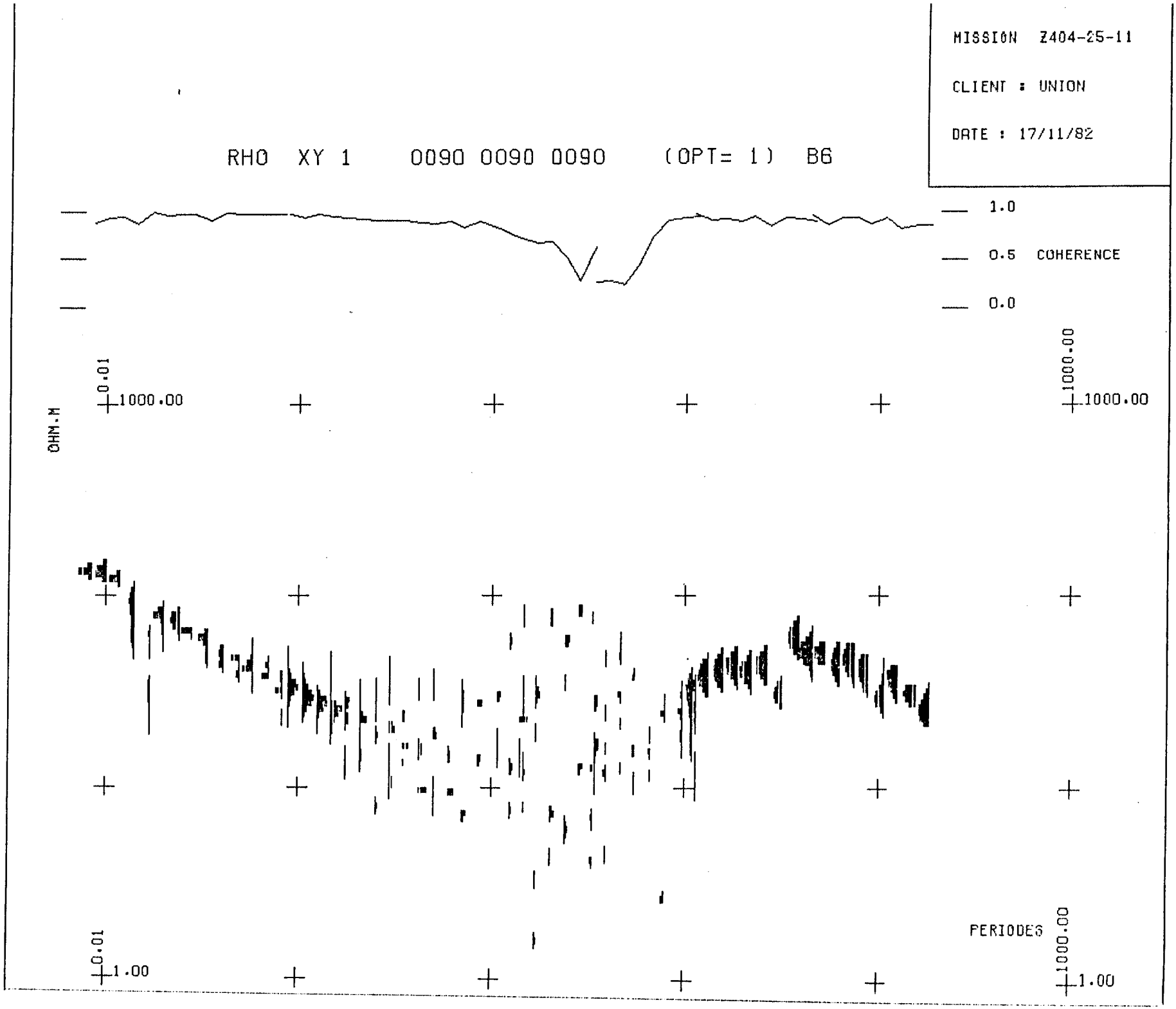
CLIENT : UNION

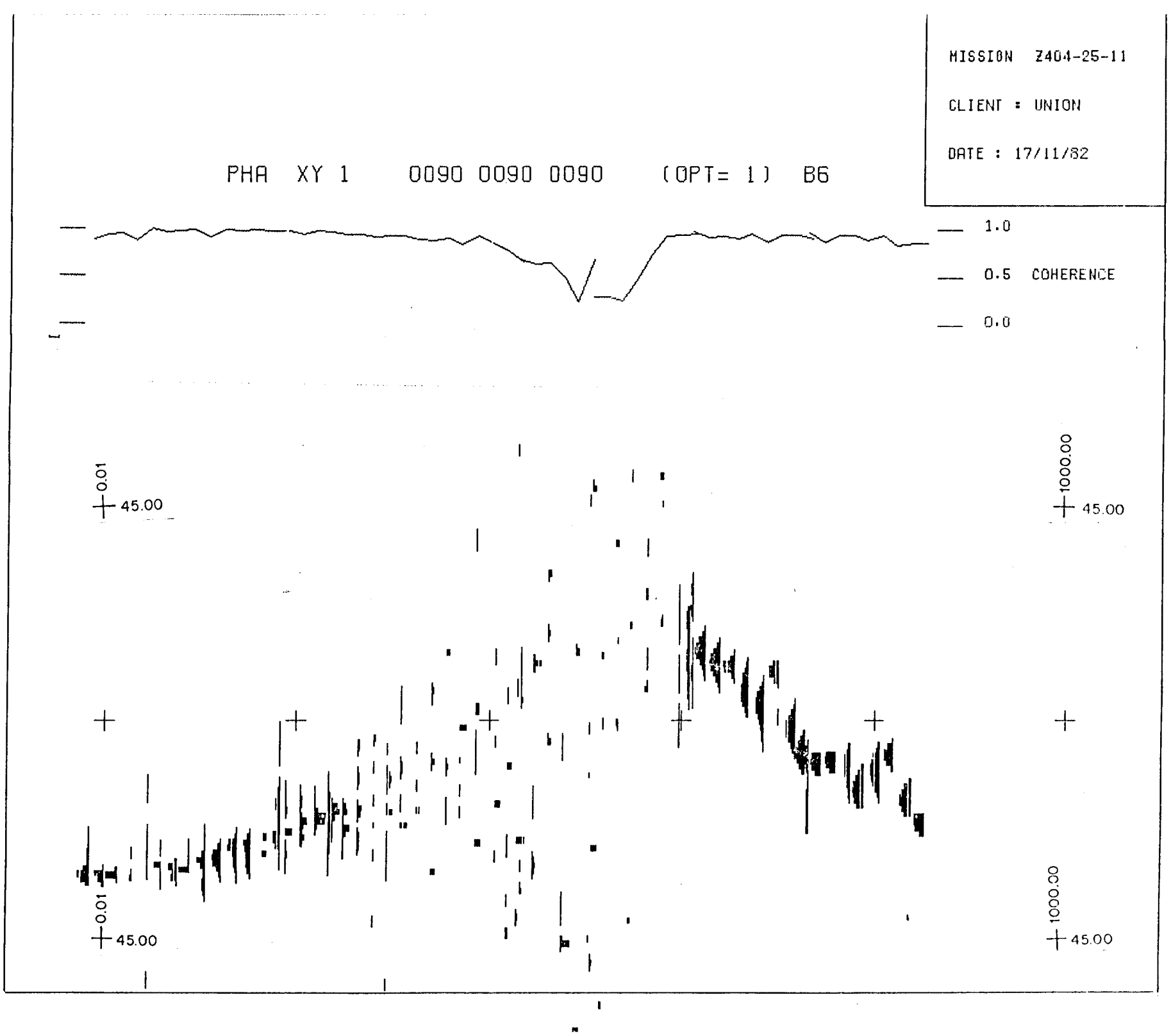
DATE : 09/11/82

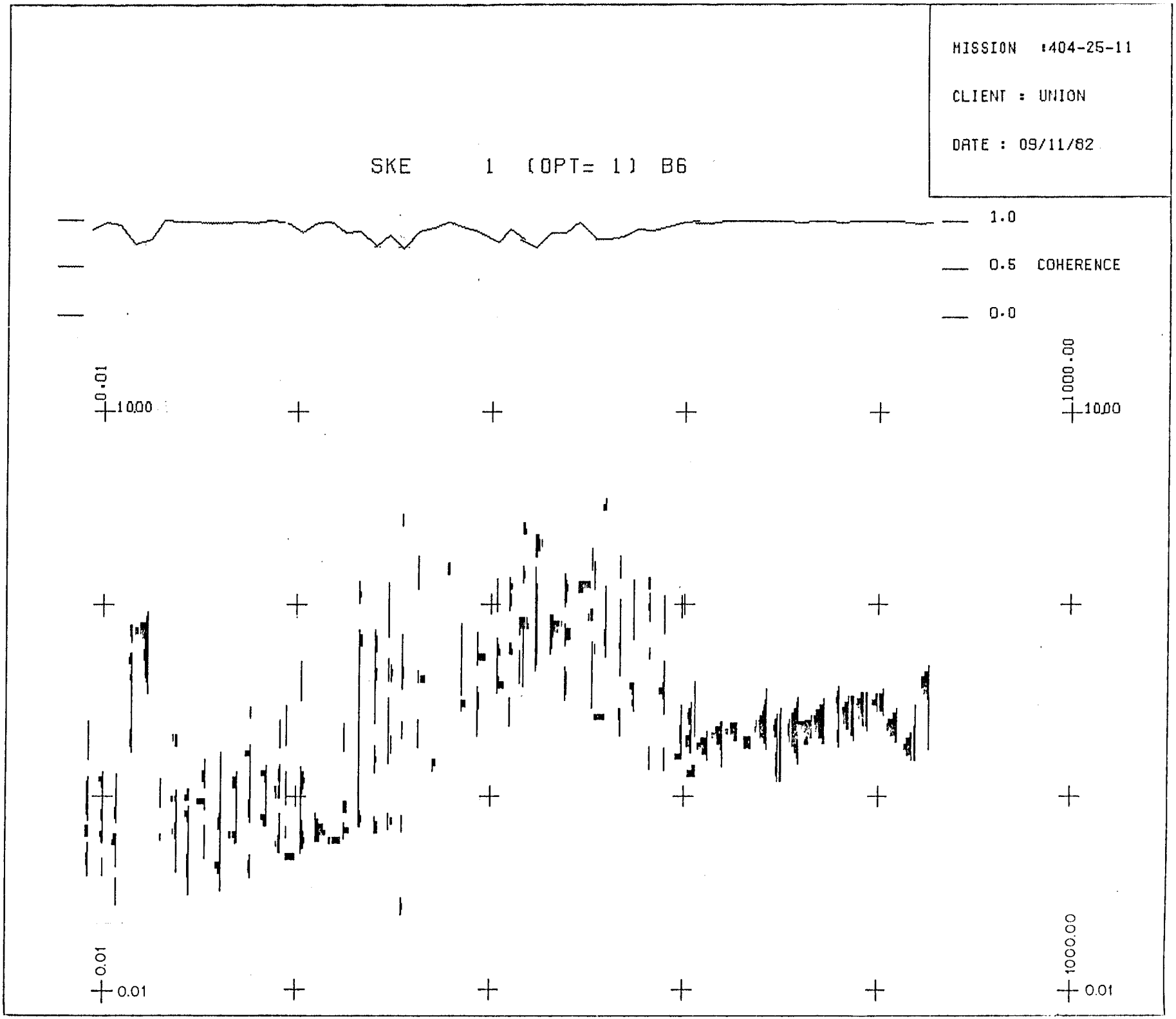


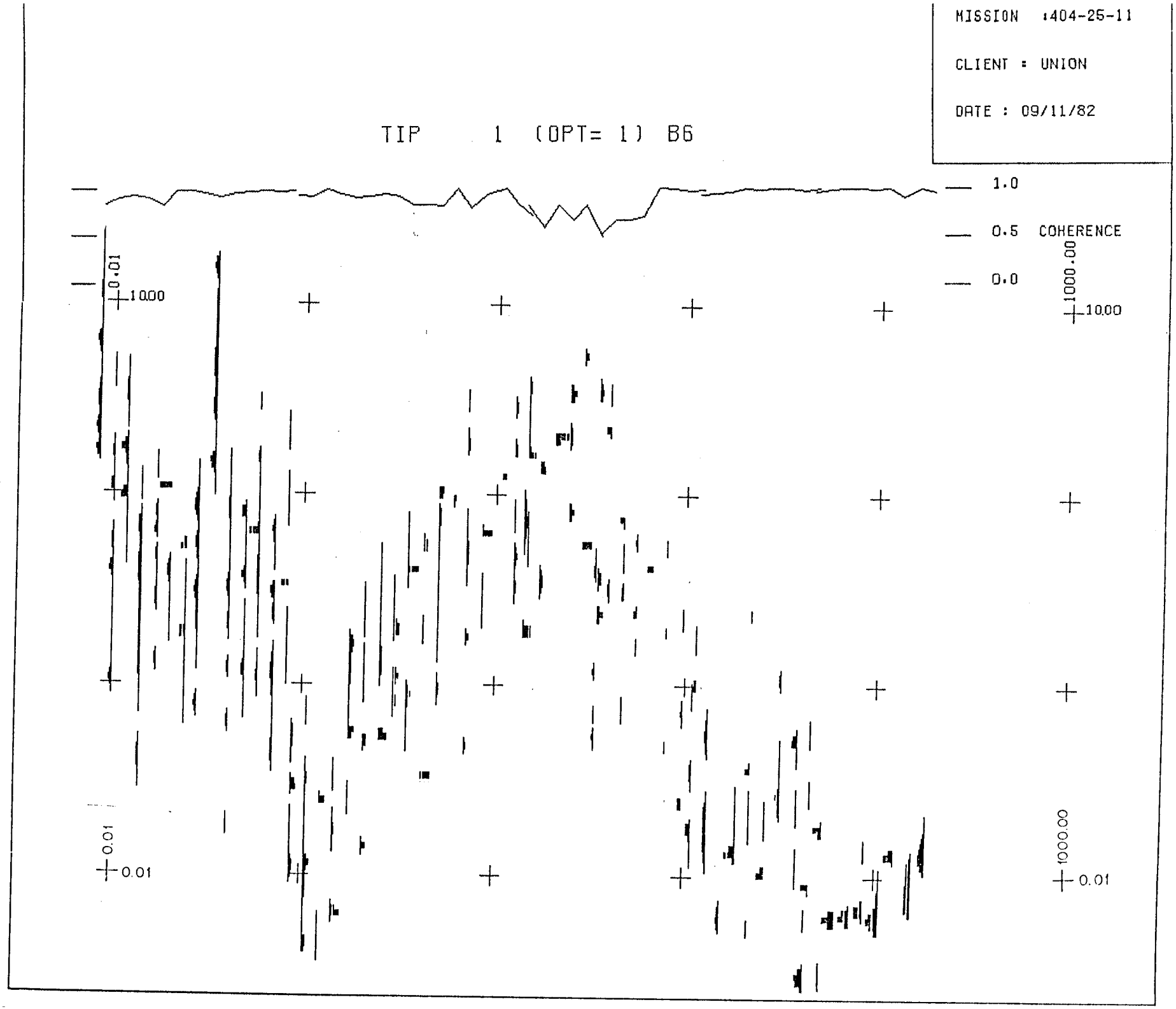

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO YX 1 0090 0090 0090 (OPT= 1) B6
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
0.01
1.00
PERIODES
1000.00
1.00

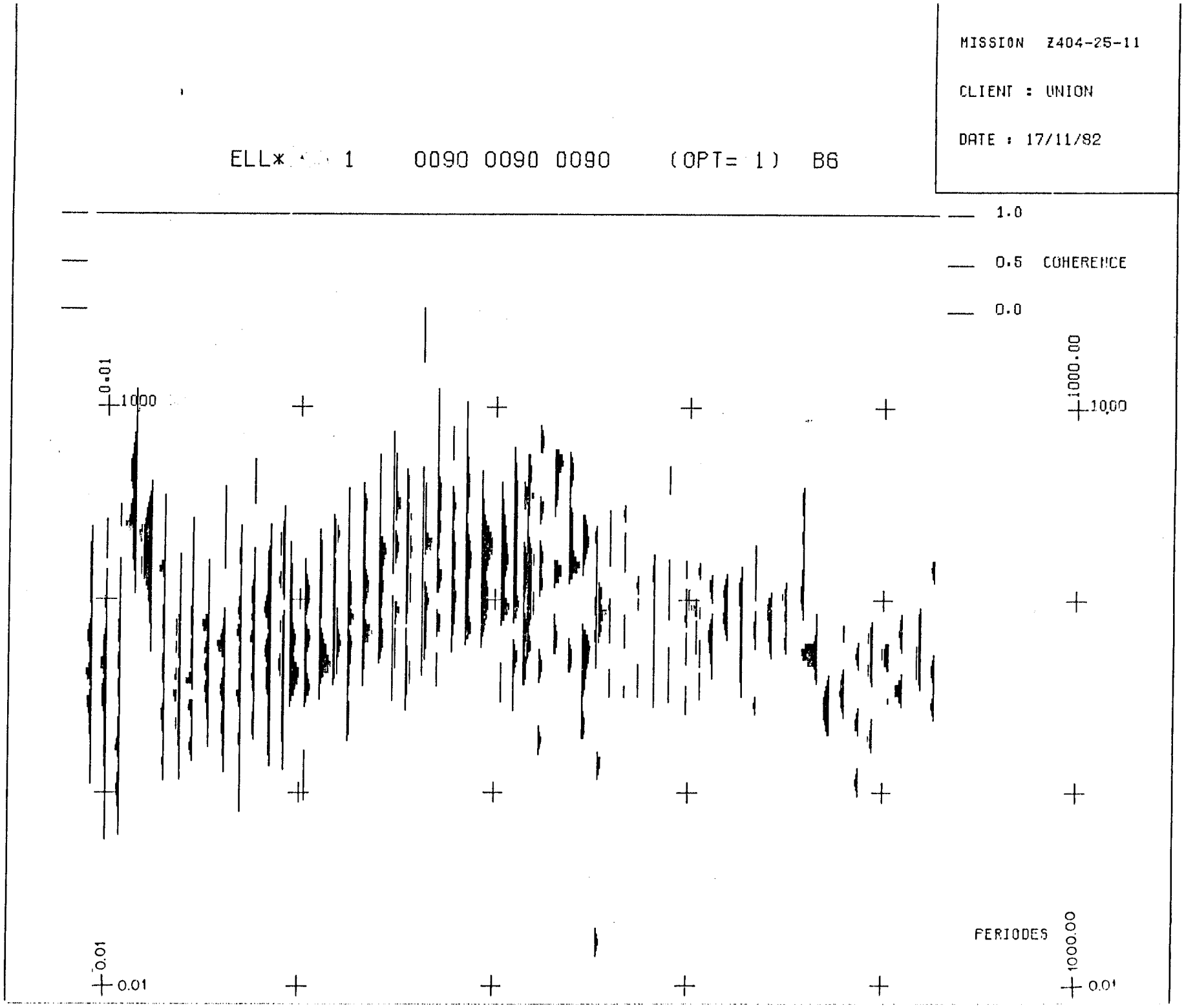

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
PHA YX 1 0090 0090 0090 (OPT= 1) B6
1.0
0.5 COHERENCE
0.0
0.01
45.00
0.01
45.00
1000.00
45.00
1000.00
45.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO XY 1 0090 0090 0090 (OPT= 1) B6
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
0.01
1.00
PERIODES
1000.00
1.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
PHA XY 1 0090 0090 0090 (OPT= 1) B6
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
SKE 1 (OPT= 1) B6
1.0
0.5 COHERENCE
0.0
0.01
10.00
1000.00
10.00
0.01
1000.00
0.01
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
TIP 1 (OPT= 1) B6
1.0
0.5 COHERENCE
0.0
0.01
10.00
0.01
0.01
1000.00
10.00
1000.00
0.01

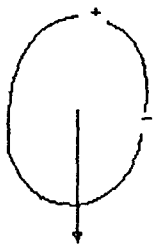

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/92
ELL* 1 0090 0090 0090 (OPT= 1) B6
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
10.00
PERIODES
0.01
0.01
1000.00
0.01

STATION B6
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 200°
SKEW = 0.191
TIPPER = 0.077
COMBINAISON 1

MISSION : 404-23-1L
CLIENT : UNION
DATE : 08/11/82

XY

MODULE 3.115 VAL. CENTRALE 10. AZIMUT DU MINIMUM 100°
MAXI 90.0 AMP ROT (MINIMUM) 60°

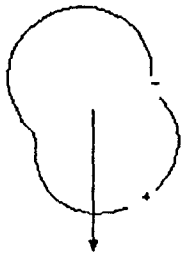


XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 60°
MAXI 5.00 AMP ROT (MINIMUM) 120°

YZ

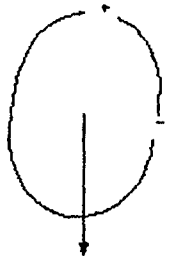
MODULE 3.196 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 100°
MAXI 0.076 AMP ROT (MAXIMUM) 30°



SKEW = 0.176
TIPPER = 0.082
COMBINAISON 2

XY

MODULE 3.226 VAL. CENTRALE 10. AZIMUT DU MINIMUM 100°
MAXI 74.0 AMP ROT (MINIMUM) 30°

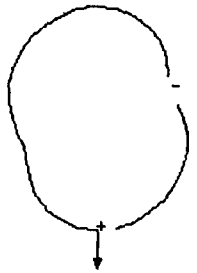


XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 60°
MAXI 5.70 AMP ROT (MINIMUM) 150°

YZ

MODULE 3.196 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 100°
MAXI 0.000 AMP ROT (MAXIMUM) 0°

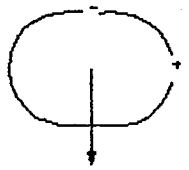


STATION B6
DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.50
AZIMUT EX 200gm
SKEW = 0.079
TIPPER = 0.030
COMBINAISON 1

REGION : 604-23-31
CLIENT : UNION
DATE : 08/11/81

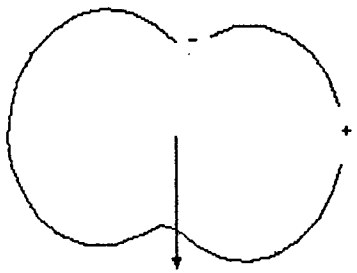
XY

MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 0°
MAXI 52.0 AND ROT (MINIMUM) 180°



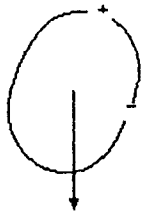
XX

MODULE 3.126 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 10°
MAXI 2.64 AND ROT (MINIMUM) 170°



YZ

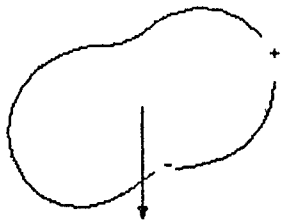
MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 20°
MAXI 0.049 AND ROT (MAXIMUM) 180°



SKEW = 0.207
TIPPER = 0.038
COMBINAISON 2

XY

MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 180°
MAXI 106.2 AND ROT (MINIMUM) 20°

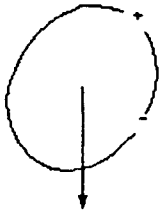


XX

MODULE 0.791 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 180°
MAXI 60.38 AND ROT (MINIMUM) 0°

YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 40°
MAXI 0.054 AND ROT (MAXIMUM) 140°



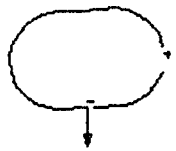
STATION B6
DOMAINE HF
DECOUPAGE EN 59
FMIN = 0.04
FMAX = 0.08
AZIMUT EX 200gm
SKEW = 0.064
TIPPER = 0.013
COMBINAISON 1

MISSION : 484-83-11
CLIENT : UNION
DATE : 09/11/83

SKEW = 0.057
TIPPER = 0.012
COMBINAISON 2

XY

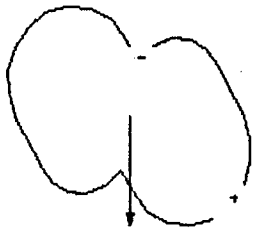
MODULE 3.13E VAL. CENTRALE 10. AZIMUT DU MINIMUM 130°
MAXI 49.3 ANG ROT (MINIMUM) 0°



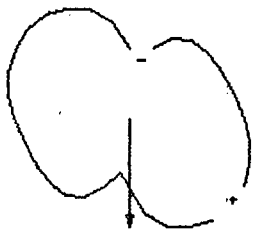
MODULE 3.13E VAL. CENTRALE 10. AZIMUT DU MINIMUM 150°
MAXI 50.6 ANG ROT (MINIMUM) 0°

XX

MODULE 1.66E VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 10°
MAXI 1.95E ANG ROT (MINIMUM) 170°

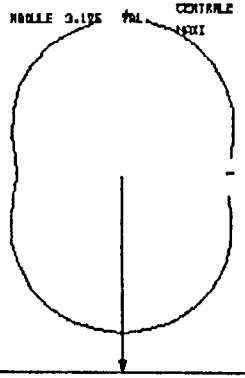


MODULE 1.66E VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 10°
MAXI 1.98E ANG ROT (MINIMUM) 170°

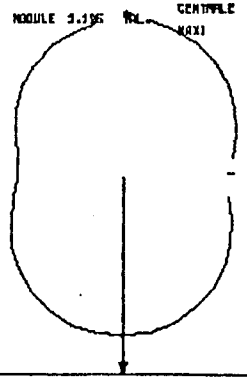


YZ

MODULE 3.13E VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 0°
MAXI 8.00E ANG ROT (MAXIMUM) 180°



MODULE 3.13E VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 0°
MAXI 8.20E ANG ROT (MAXIMUM) 180°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 7

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/22 | 60<br>64 | A<br>B | 59<br>63 | A<br>B | 61<br>62 | B<br>A |

| FIELD ARRAY | AZ. | Cent. ° | Sex. ° = Azimuth |
|---|---|---|---|
| | Ex | 275 | 247.5 = 112°5W |
| | Ey | 175 | 157.5 = 157°5E |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 77°5E | 170 | 77.5 = 77.5E | XY | YX |
| STRIKE from Hz | 54°E | | | | |

## COMMENTS

### FIELD

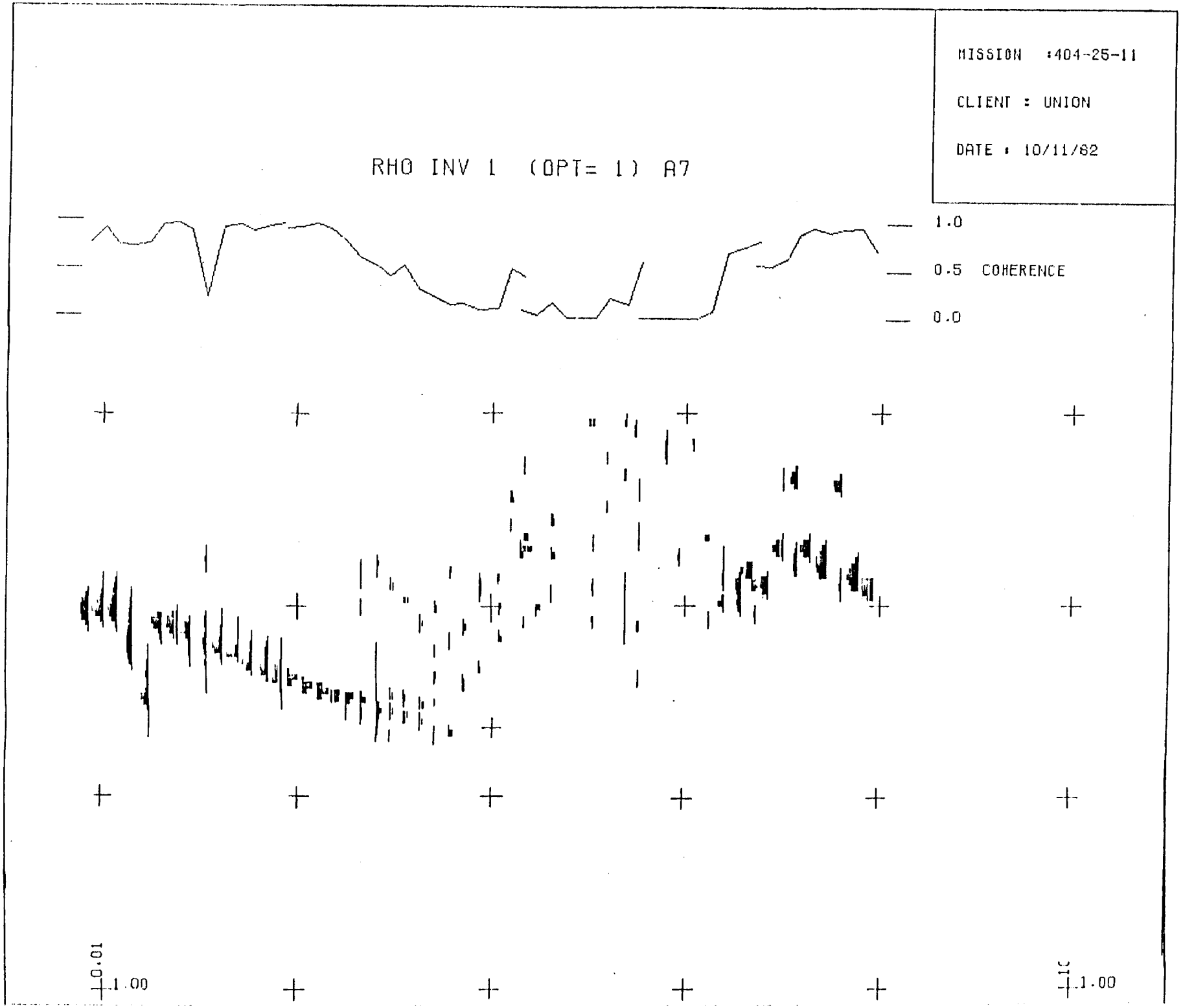
Fog - Rain - Wind - (trucks)

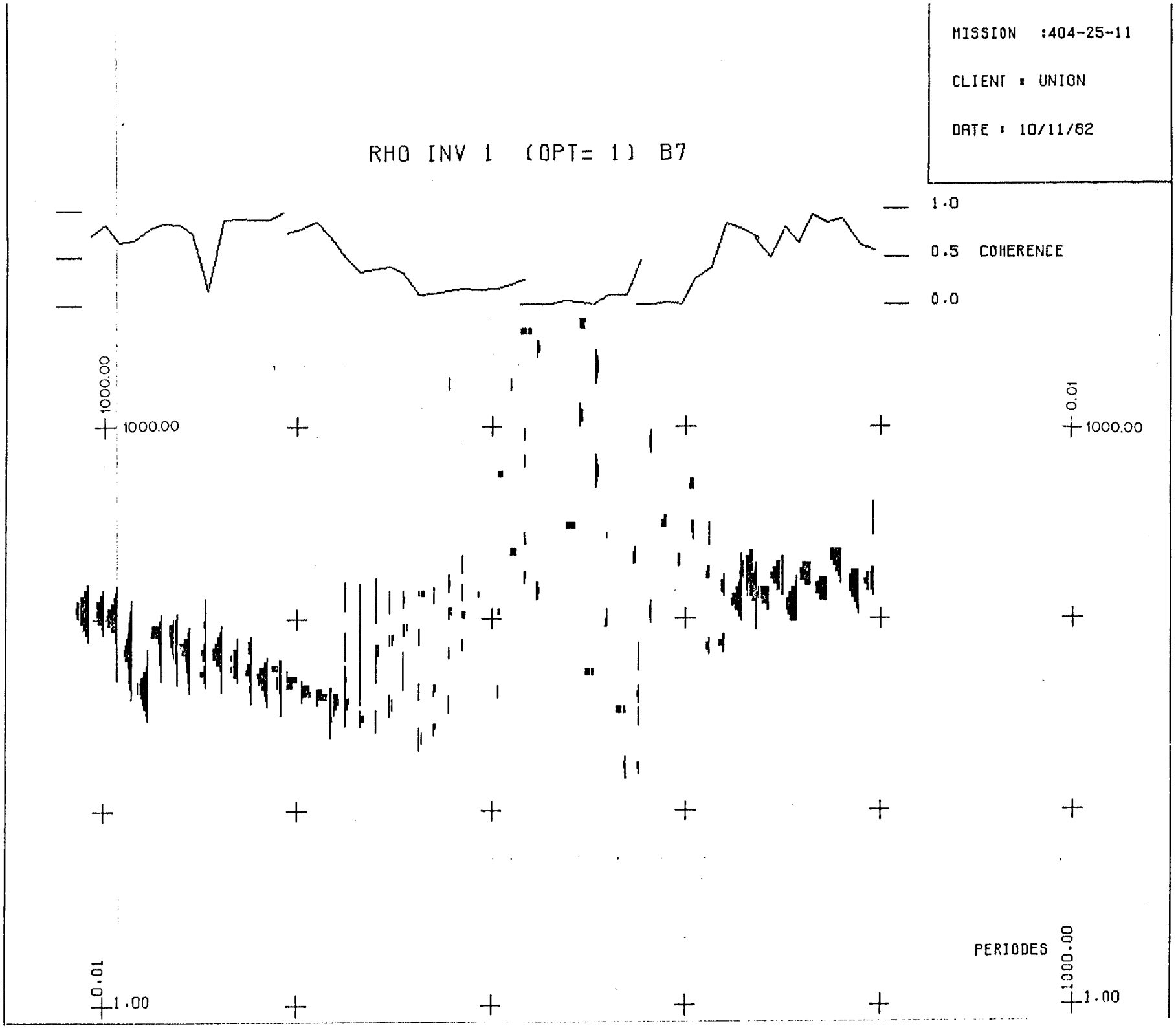
MF - HF: noisy

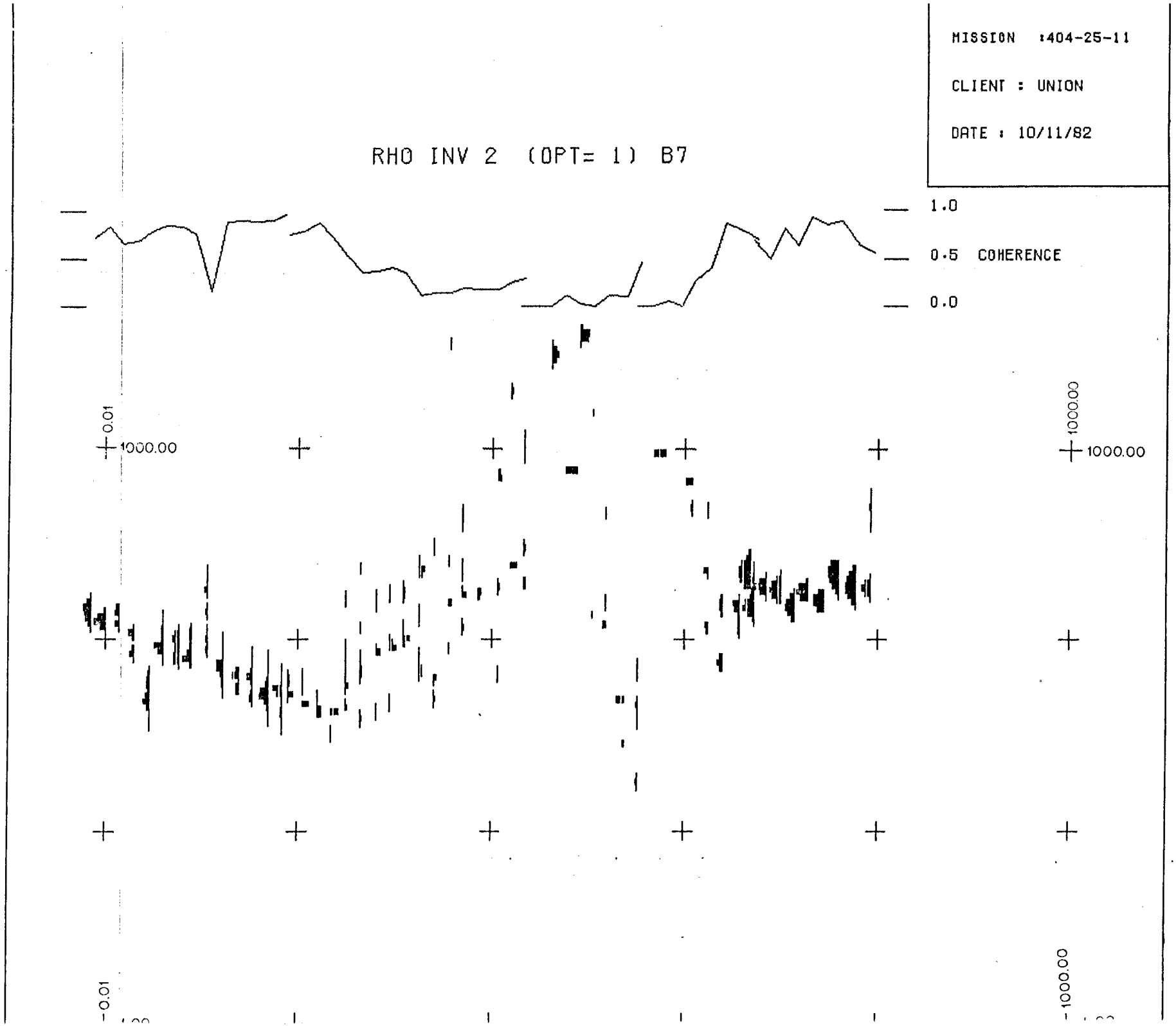
### PROCESSING

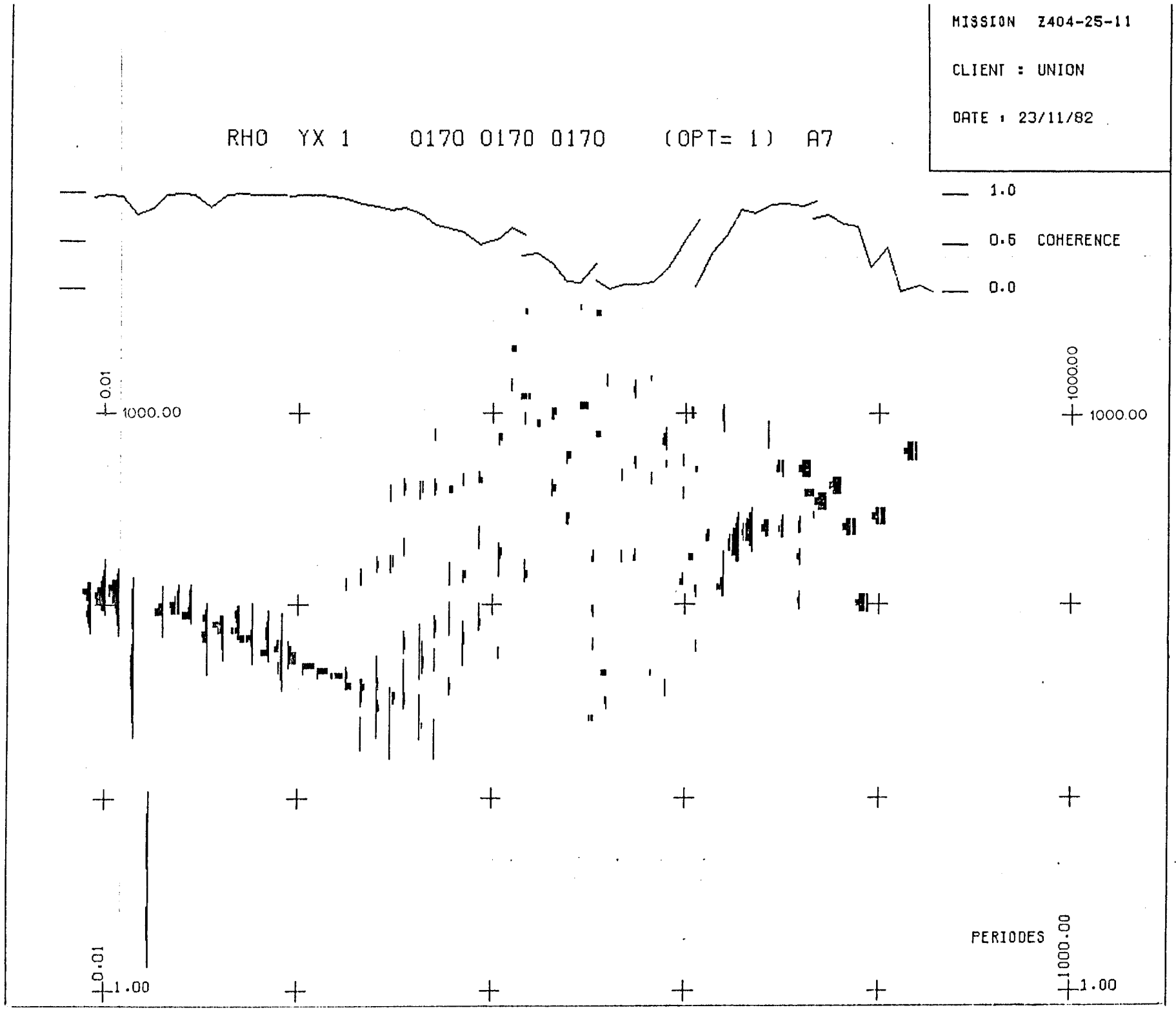
low quality

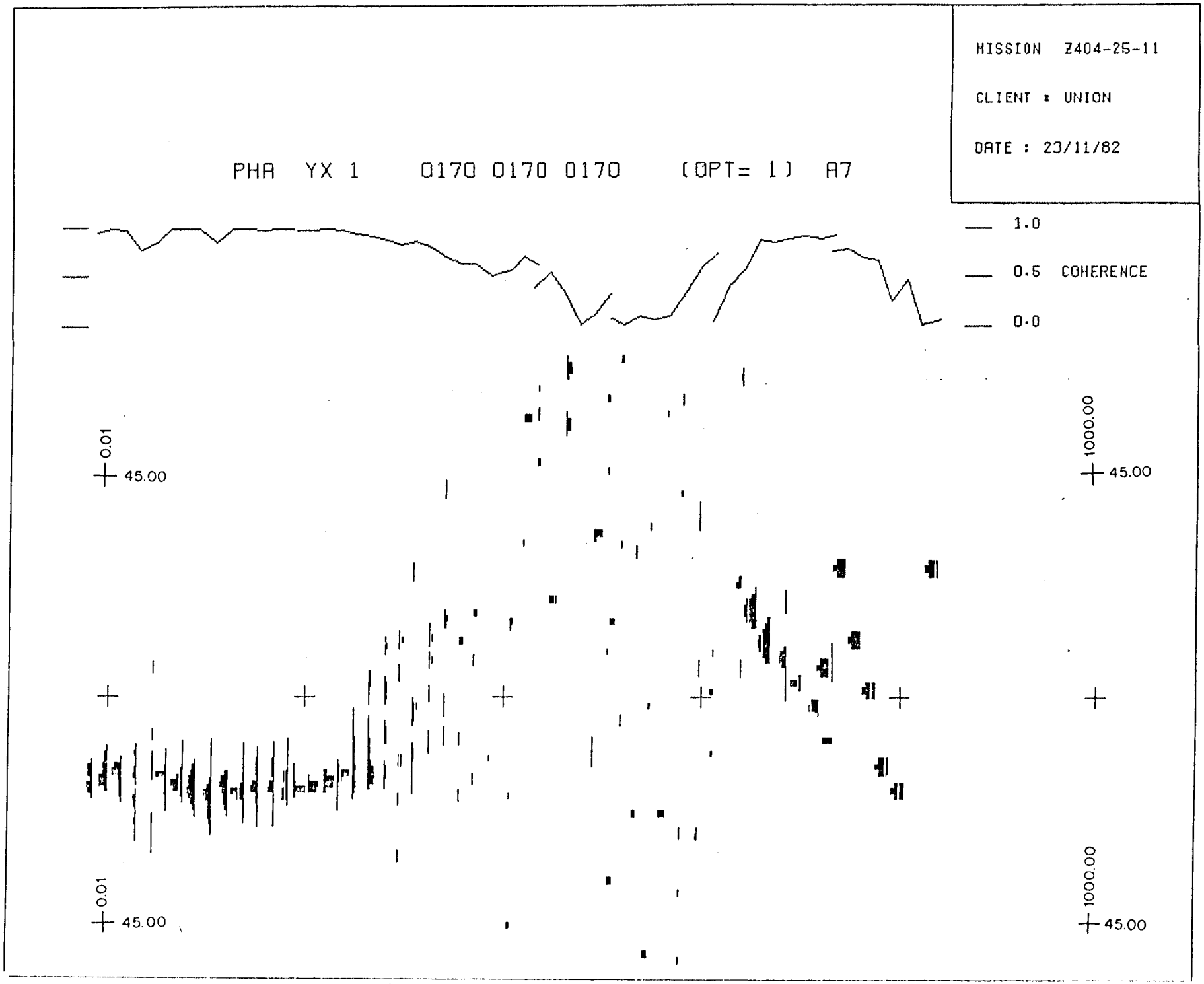
LF: $\rho E < \rho H$

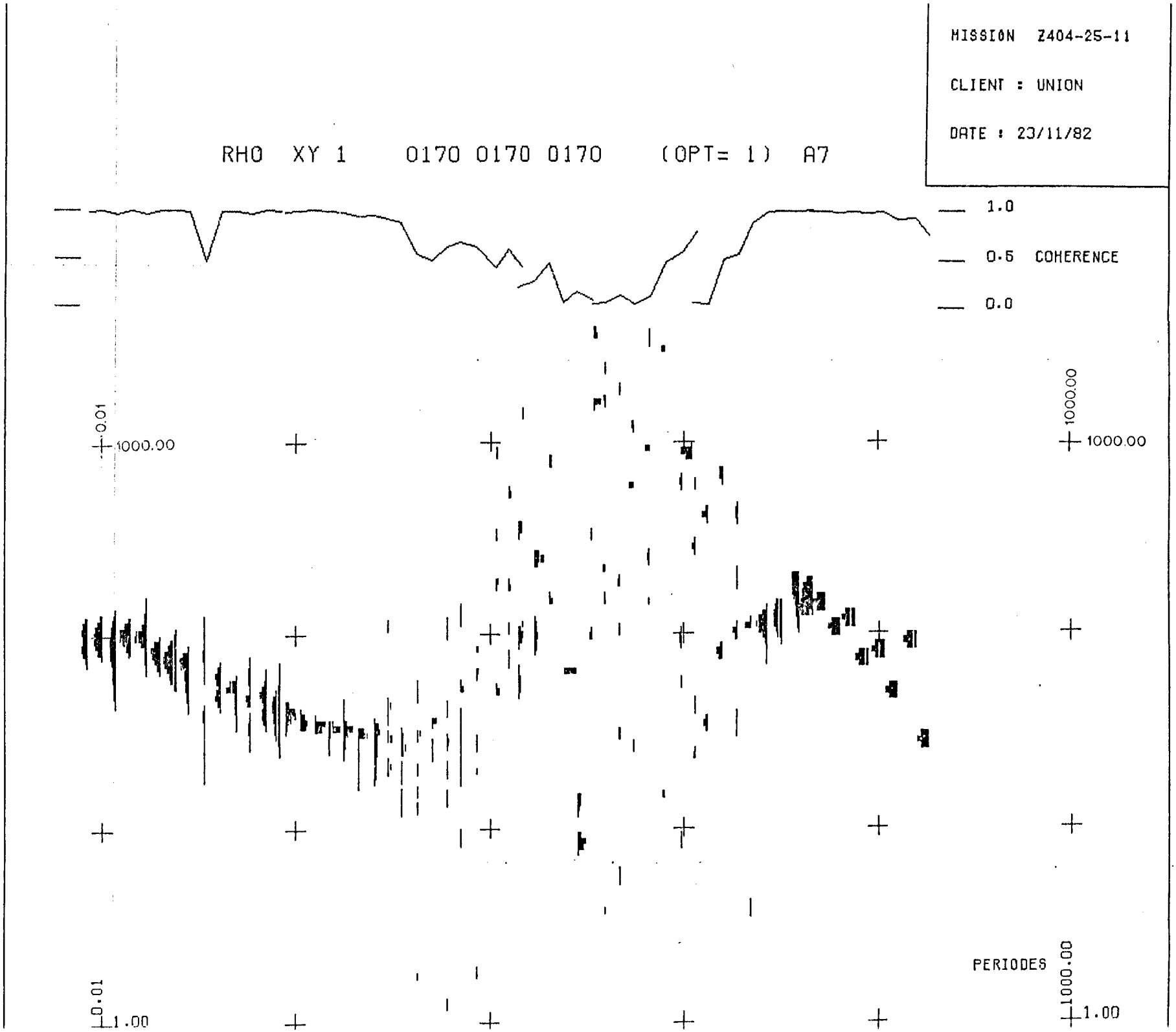

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
RHO INV 1 (OPT= 1) A7
1.0
0.5 COHERENCE
0.0
0.01
1.00
1.00

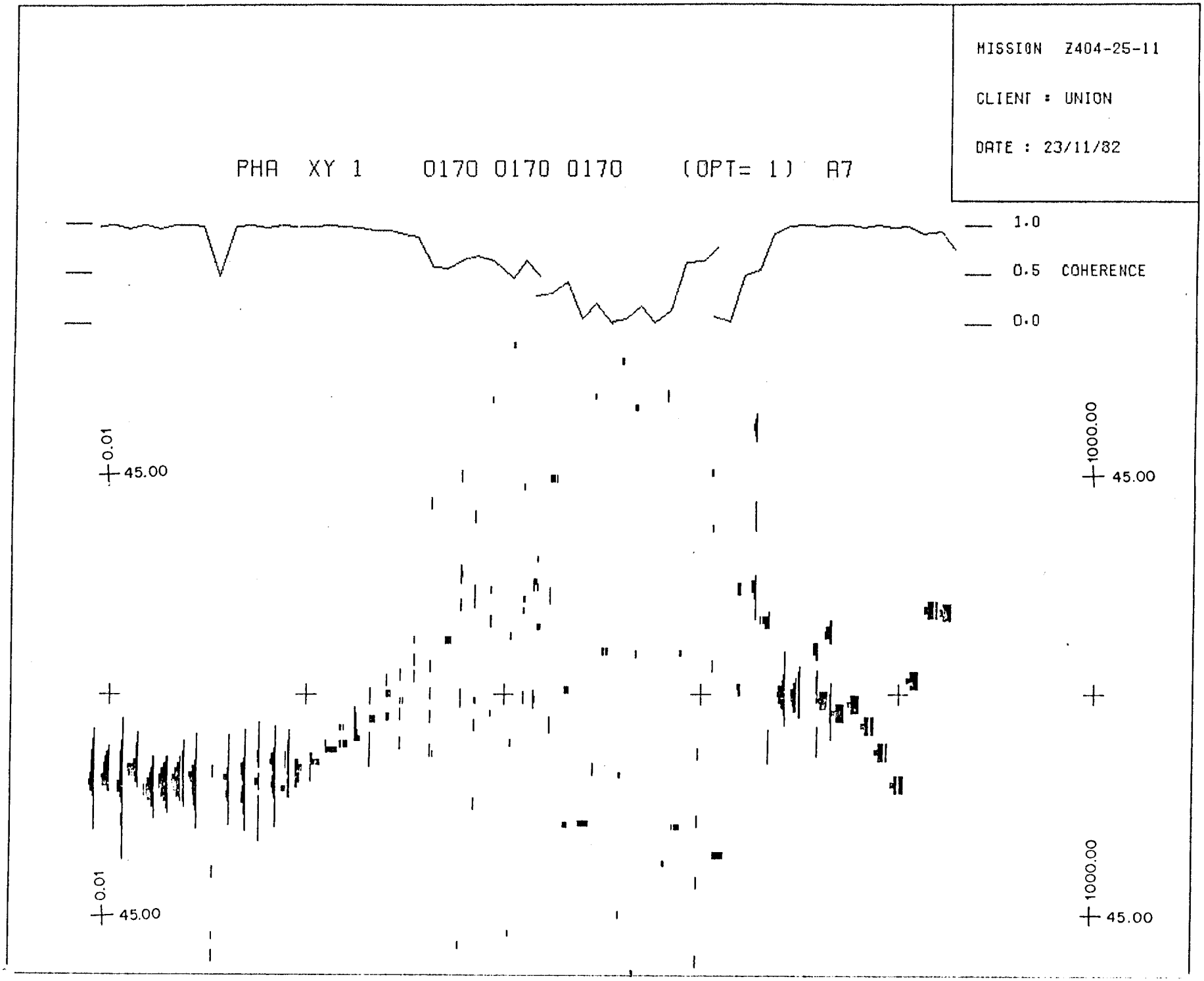

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
RHO INV 1 (OPT= 1) B7
1.0
0.5 COHERENCE
0.0
1000.00
1000.00
0.01
1000.00
PERIODES
0.01
1.00
1000.00
1.00

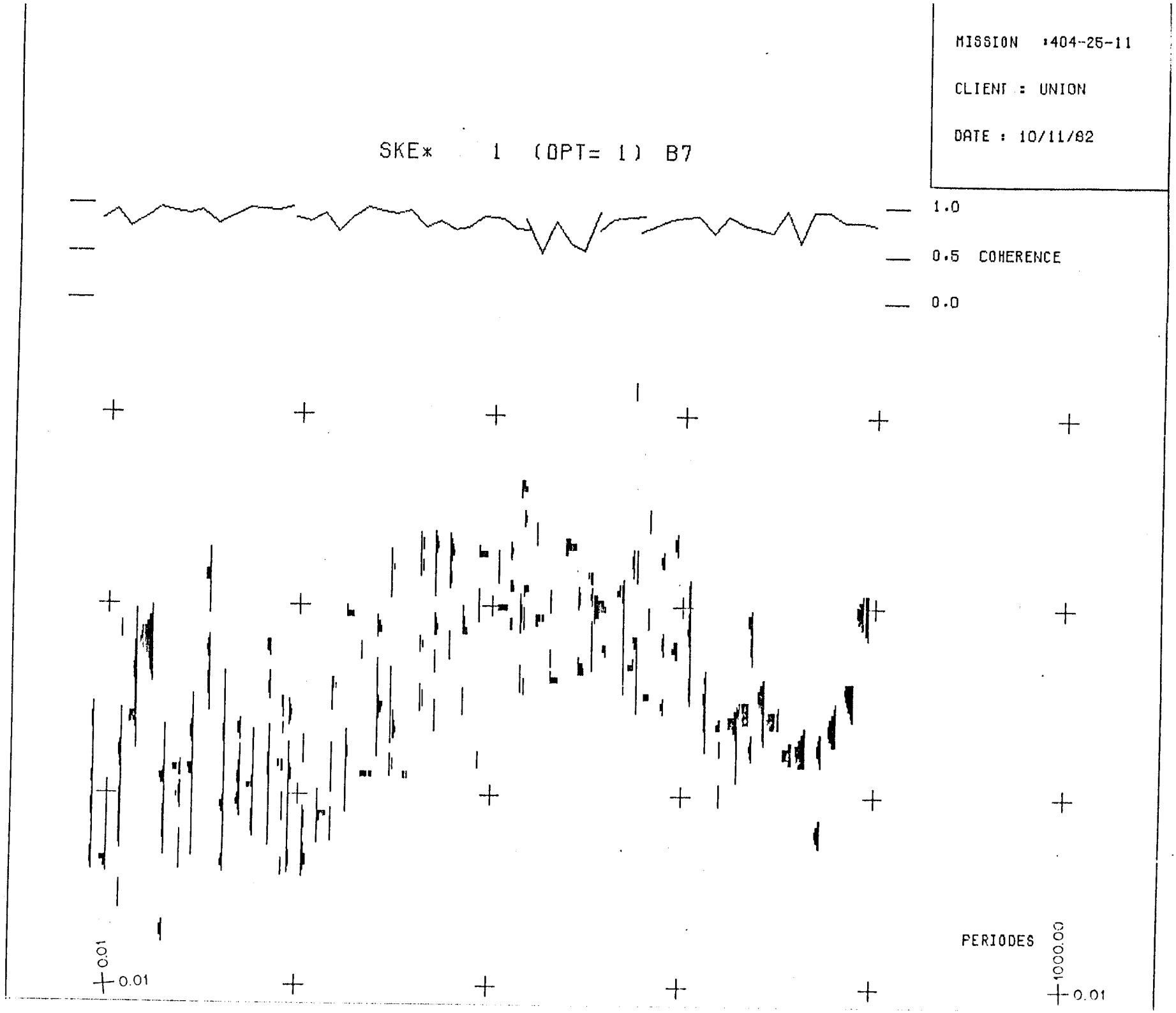

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
RHO INV 2 (OPT= 1) B7
1.0
0.5 COHERENCE
0.0
0.01
1000.00
-0.01
1000.00
1000.00
-1000.00

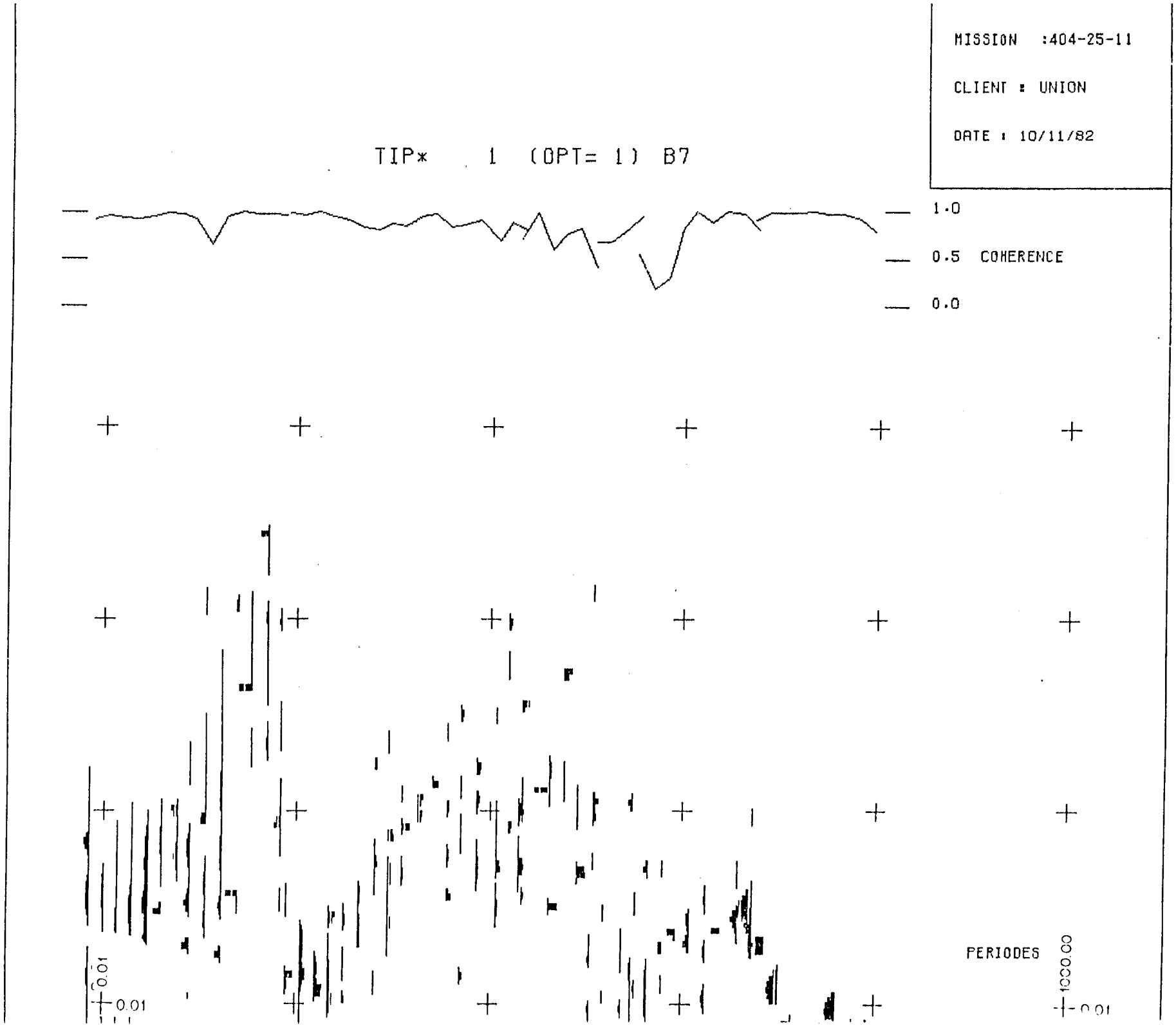

MISSION Z404-25-11
CLIENT : UNION
DATE : 23/11/82
RHO YX 1 0170 0170 0170 (OPT= 1) A7
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 23/11/82
PHA YX 1 0170 0170 0170 (OPT= 1) A7
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 23/11/82
RHO XY 1 0170 0170 0170 (OPT= 1) A7
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 23/11/82
PHA XY 1 0170 0170 0170 (OPT= 1) A7
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
SKE* 1 (OPT= 1) B7
1.0
0.5 COHERENCE
0.0
PERIODES
0.01
0.01
1000.00
0.01

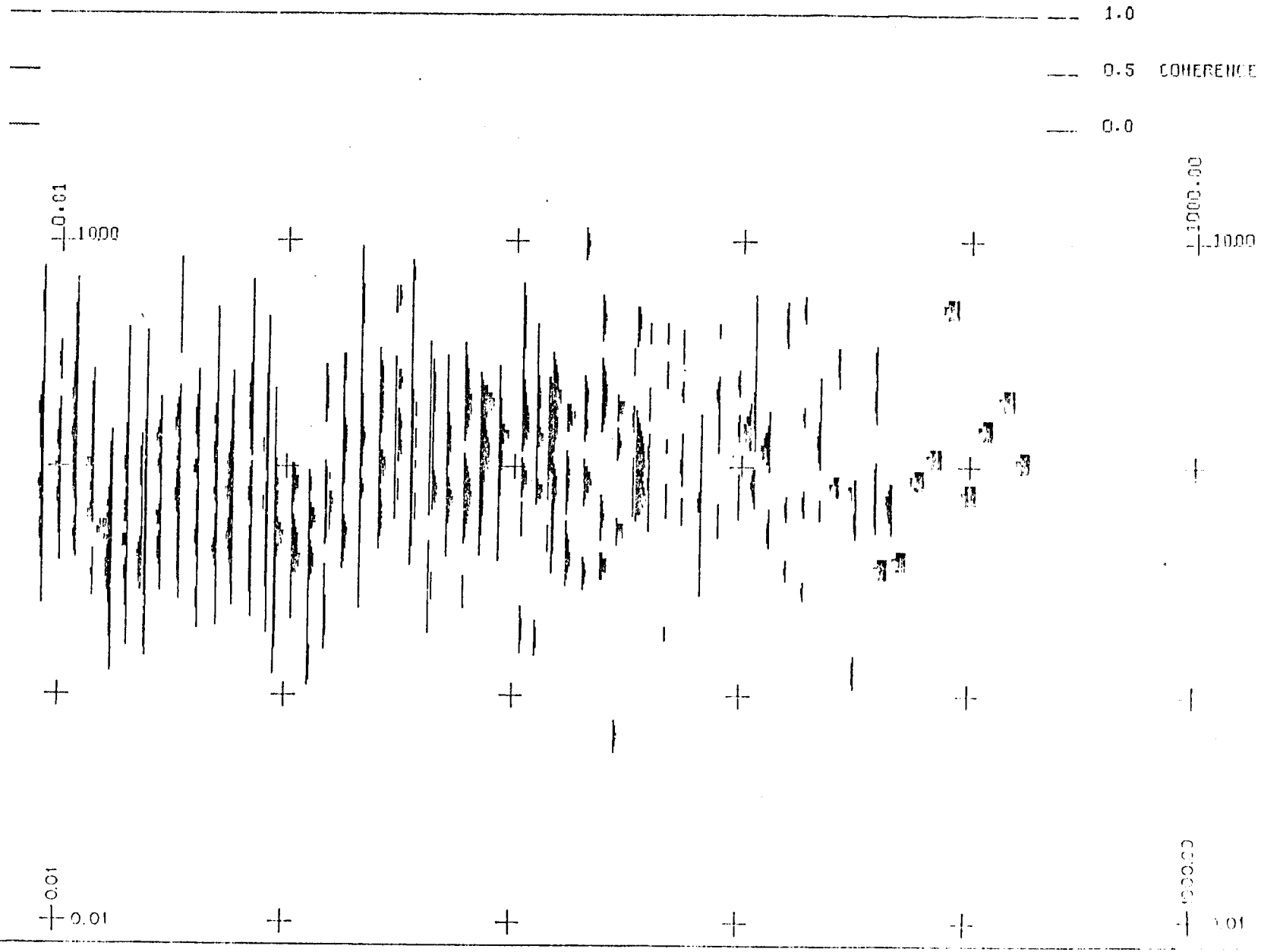

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
TIP* 1 (OPT= 1) B7
1.0
0.5 COHERENCE
0.0
0.01
0.01
PERIODES
1000.00
0.01

MISSION Z404-25-11

CLIENT : UNION

DATE : 23/11/82

ELL 1 0170 0170 0170 (OPT= 1) A7

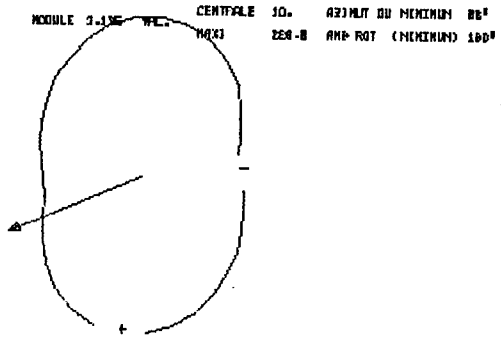


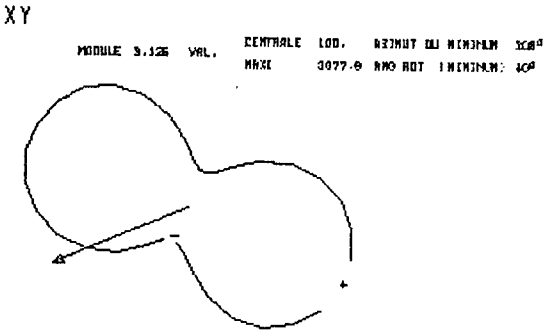
STATION A7
DOMAINE BF
DECOUPAGE EN 4
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 275DR
SKEW = 0.274
TIPPER = 0.133
COMBINAISON 1

MISSION : :404-25-11
CLIENT : SNIGN
DATE : 18/11/82

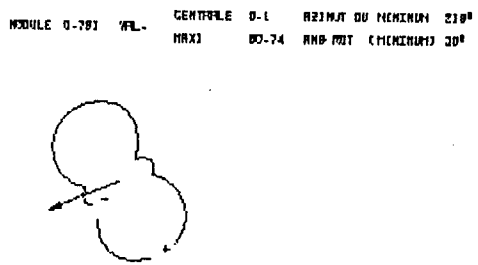
SKEW = 0.279
TIPPER = 0.126
COMBINAISON 2

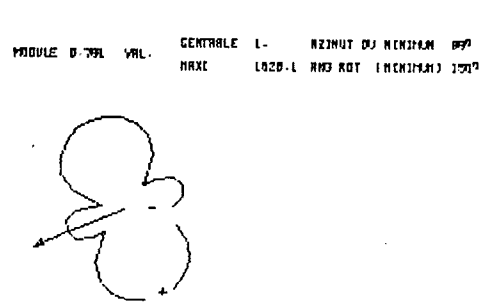
XY



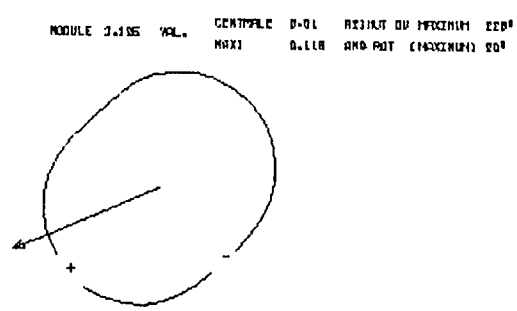



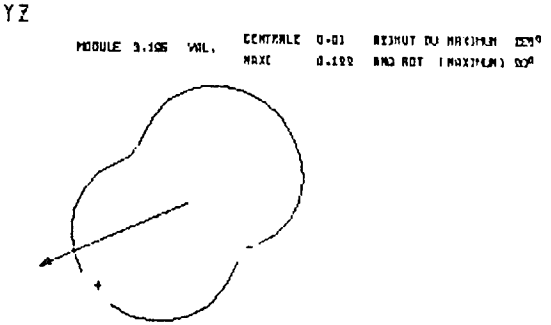

XX




YZ

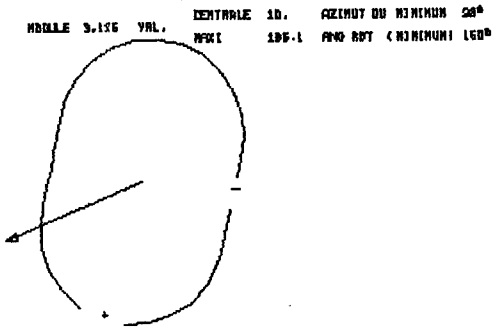


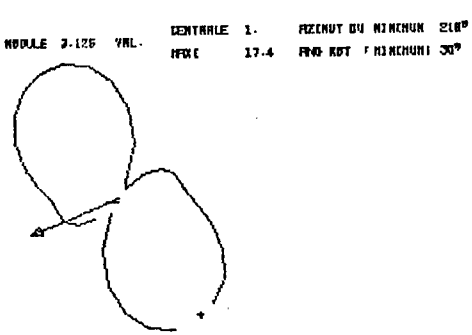
MISSION : =404-83-11
CLIENT : UNION
DATE : 10/11/83

STATION B7
DOMAINE BF
DECOUPAGE EN 8
TMIN = 11.13
TMAX = 23.27
AZIMUT EX 275GM
SKEW = 0.135
TIPPER = 0.140
COMBINAISON 1

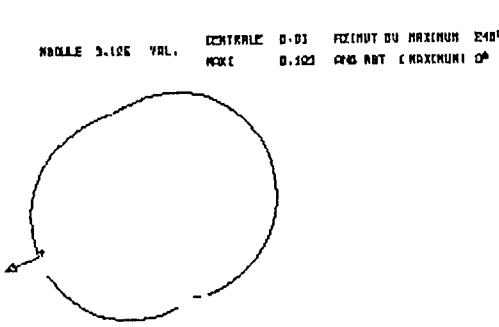
XY




XX

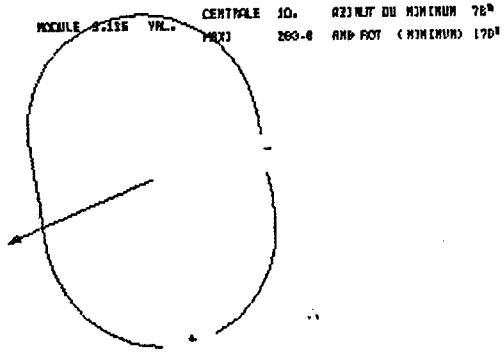



YZ

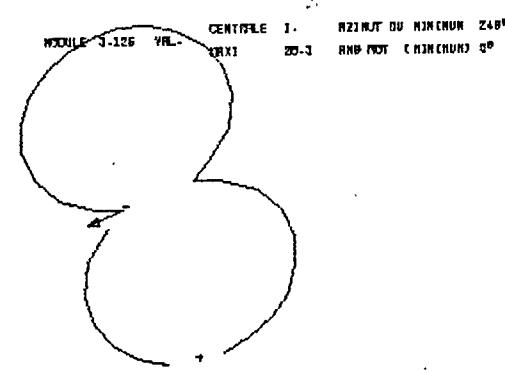



SKEW = 0.128
TIPPER = 0.145
COMBINAISON 2

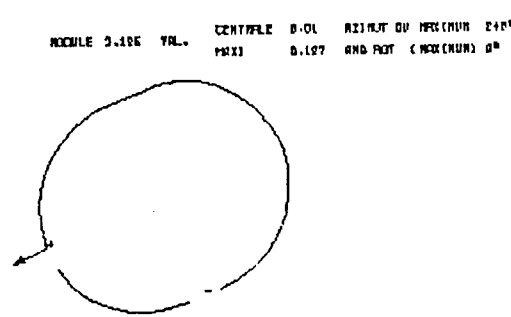
XY




XX



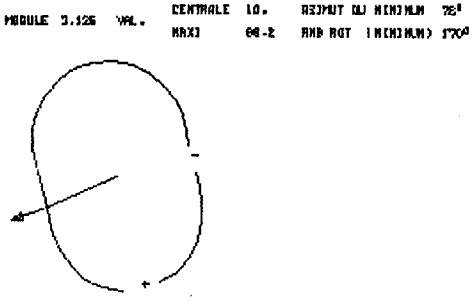

YZ



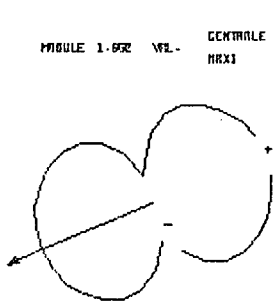
STATION A7
DOMAINE NF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.50
AZIMUT EX 275mn
SKEW = 0.088
TIPPER = 0.108
COMBINAISON 1

MISSION : 404-85-11
CLIENT : UNION
DATE : 12/11/82

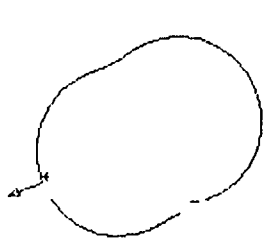
XY




XX

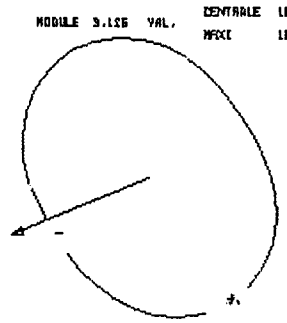



YZ

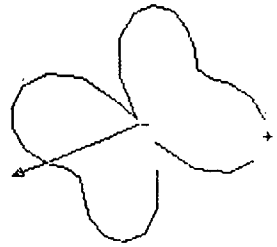



SKEW = 0.059
TIPPER = 0.122
COMBINAISON 2

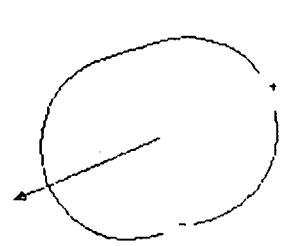
XY




XX




YZ

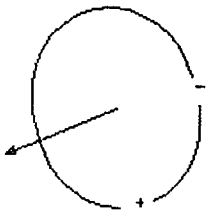


STATION A7
DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 275gm
SKEW = 0.045
TIPPER = 0.102
COMBINAISON 1

MISSION : 1404-25-11
CLIENT : UNION
DATE : 18/11/82

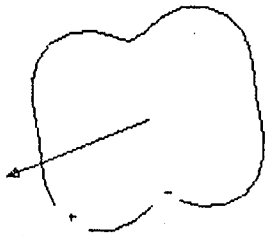
XY

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 78°
MAXI 72.2 ANG ROT (MINIMUM) 170°



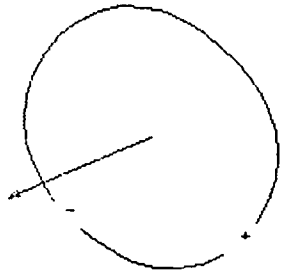
XX

MODULE 3.125 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 169°
MAXI 1.30 ANG ROT (MINIMUM) 80°



YZ

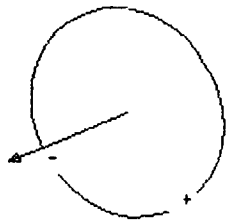
MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 170°
MAXI 0.148 ANG ROT (MAXIMUM) 110°



SKEW = 0.070
TIPPER = 0.116
COMBINAISON 2

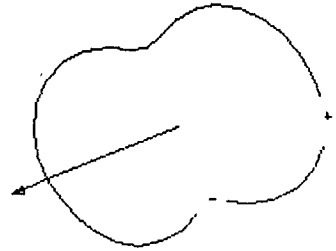
XY

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 258°
MAXI 62.6 ANG ROT (MINIMUM) 10°



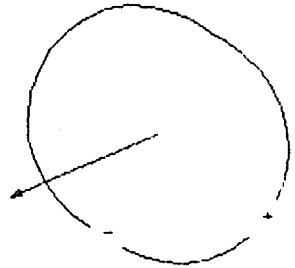
XX

MODULE 3.125 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 258°
MAXI 1.33 ANG ROT (MINIMUM) 80°



YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 260°
MAXI 0.142 ANG ROT (MAXIMUM) 100°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 8

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/15 | 13 | A | 12 | A | 14 | A-B |
| | 16 | B | 15 | B | | |

| FIELD ARRAY | AZ. | Cent. º | Sex. º = Azimuth |
|---|---|---|---|
| | Ex | 125 | 112.5 = 112° 5E |
| | Ey | 25 | 22.5 = 22° 5E |

| STRIKE | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| from Exy, Hxy | 17°5W | 130 | 342.5 = 17.5W | XY | YX |
| STRIKE from Hz | 8°E | | | | |

## COMMENTS

### FIELD

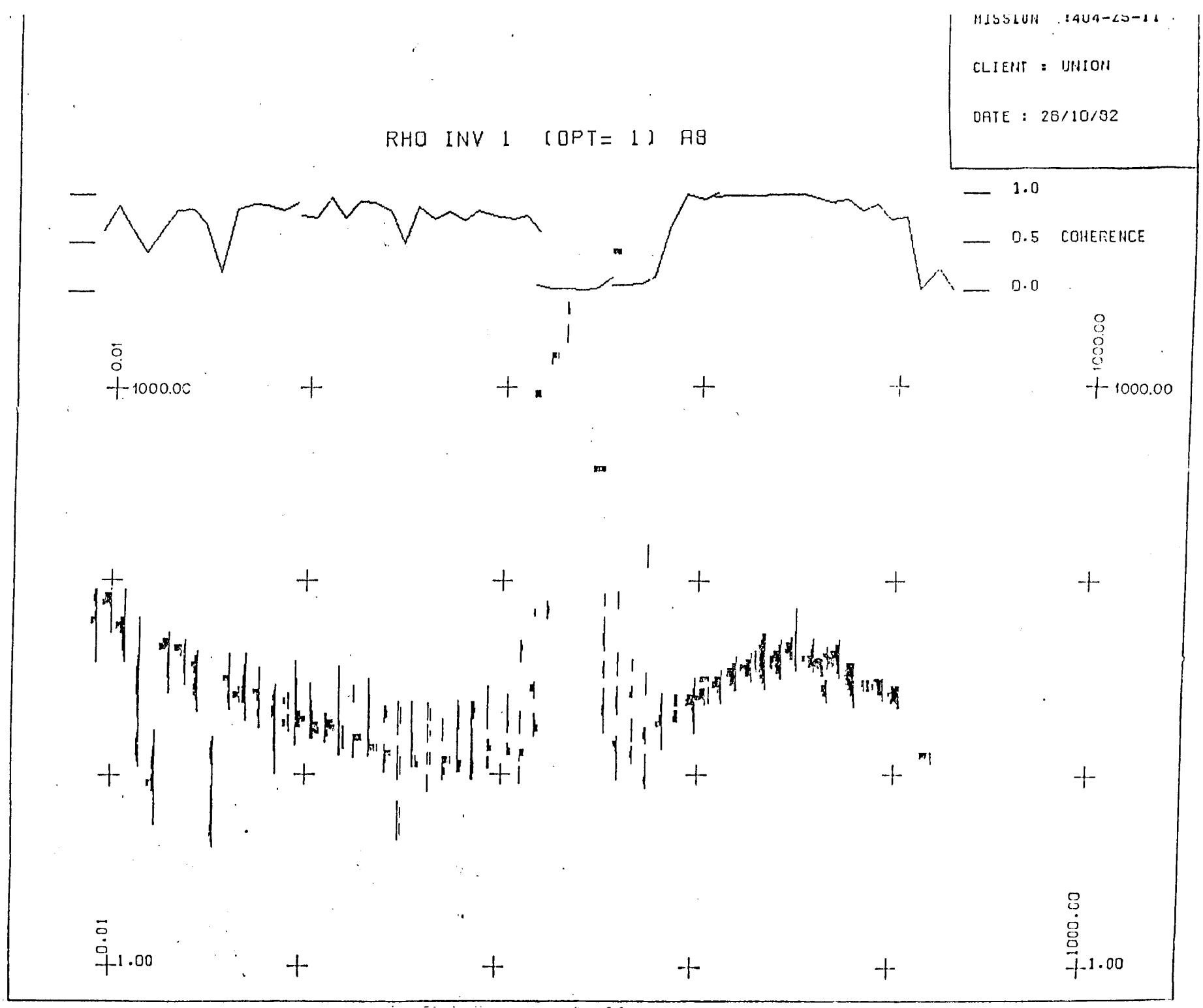
Fair signal
slight thunderstorm

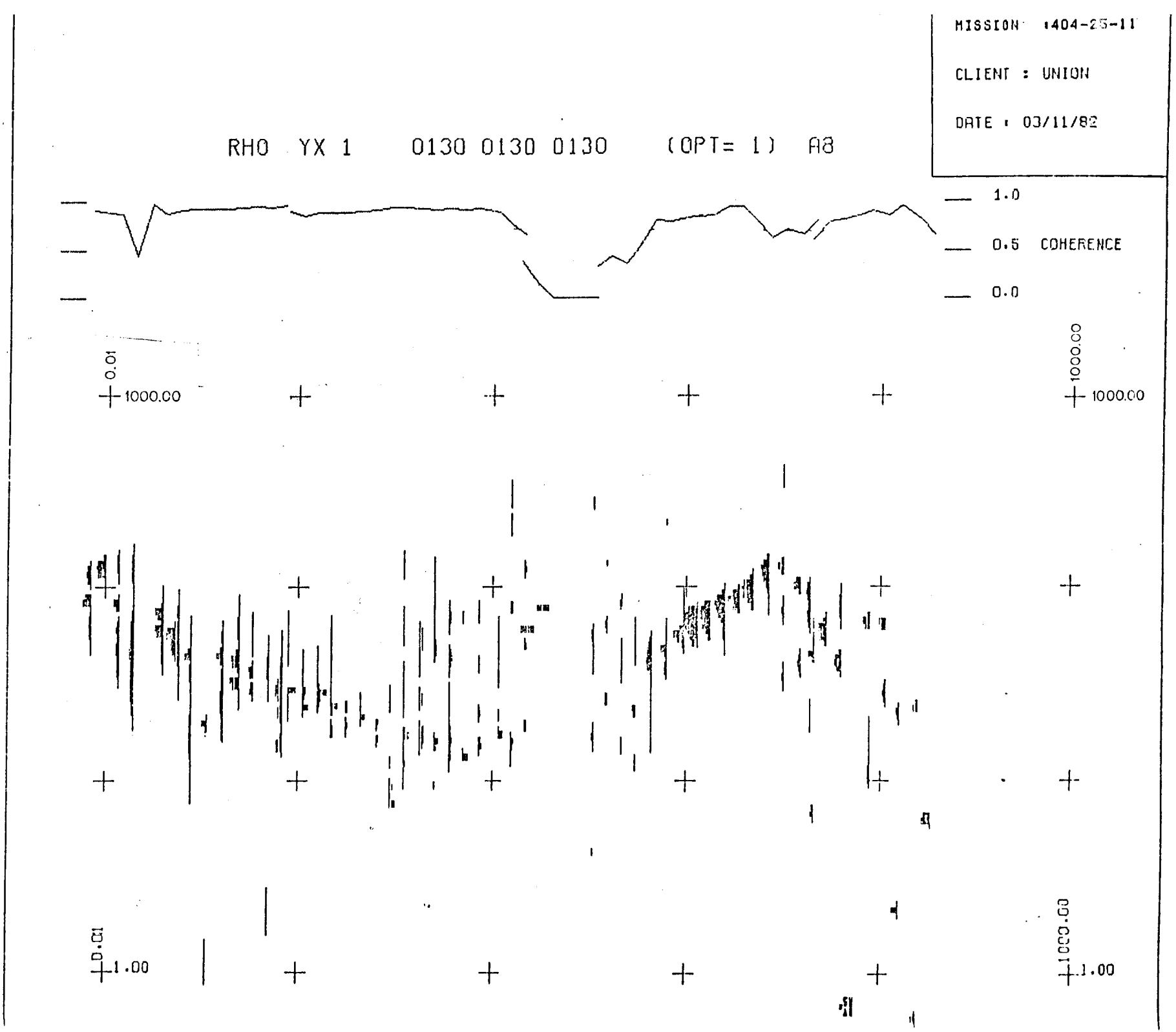
### PROCESSING

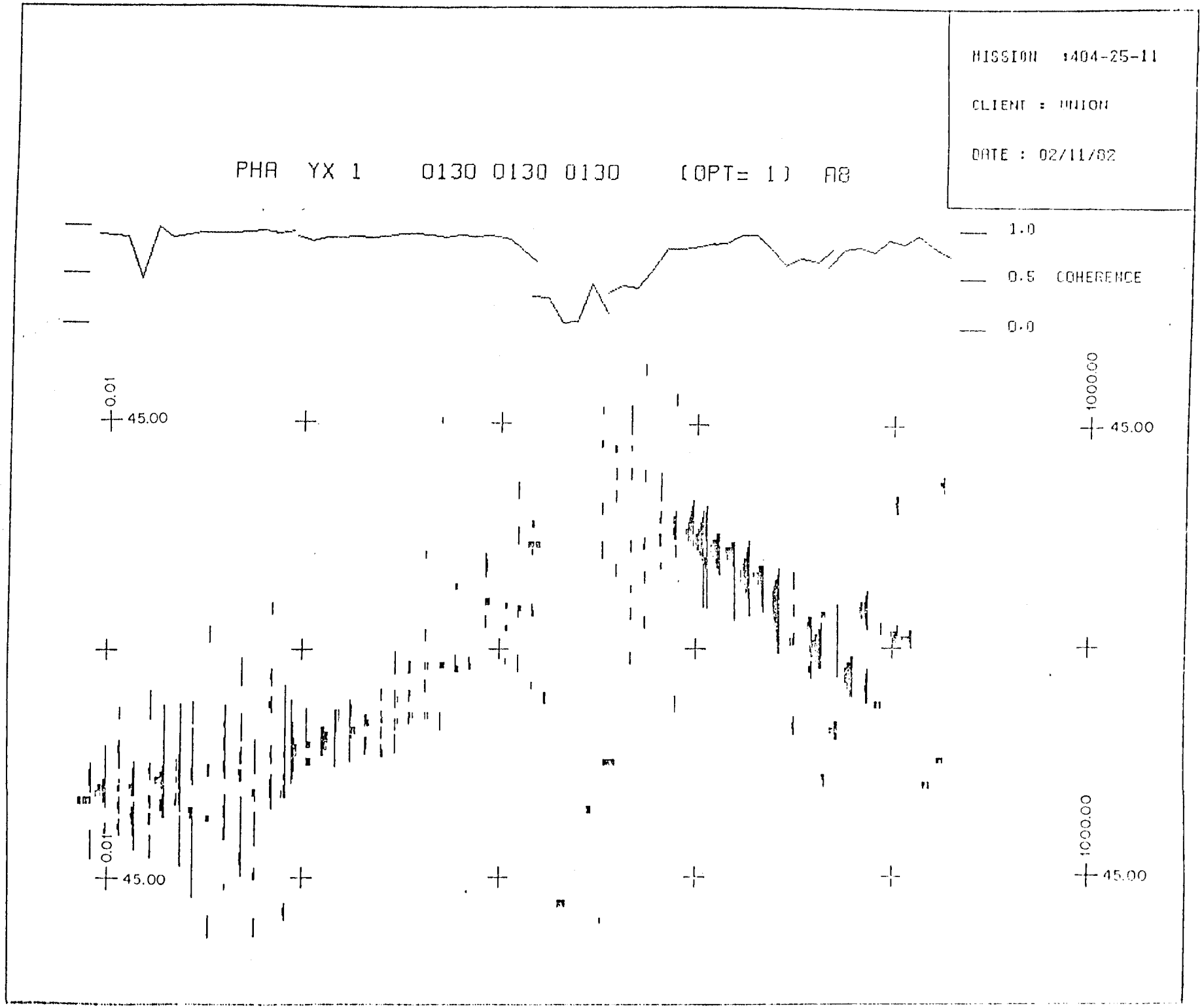
Fair

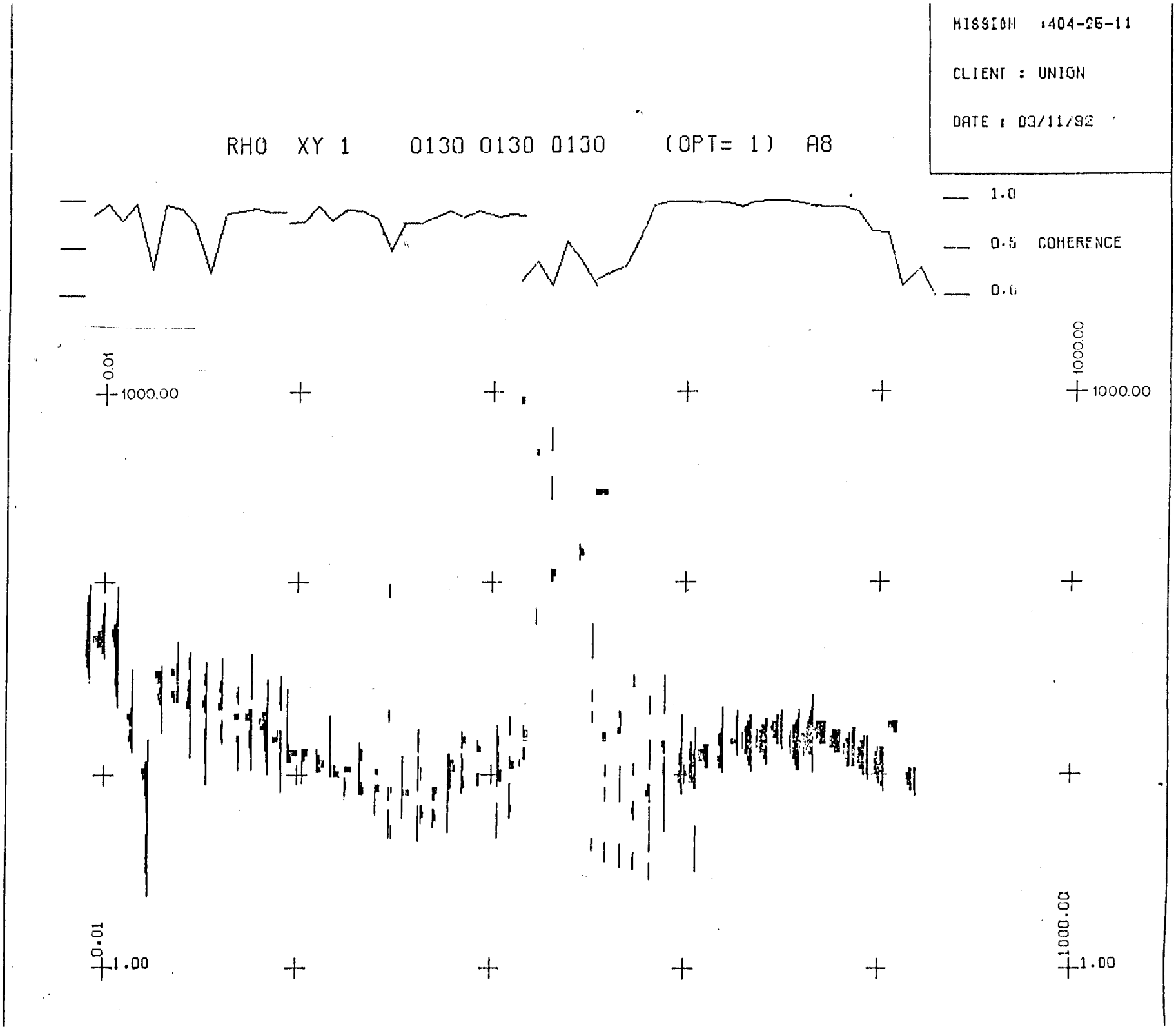
HF: $\rho E < \rho H$
LF: $\rho E < \rho H$
Low Tipper

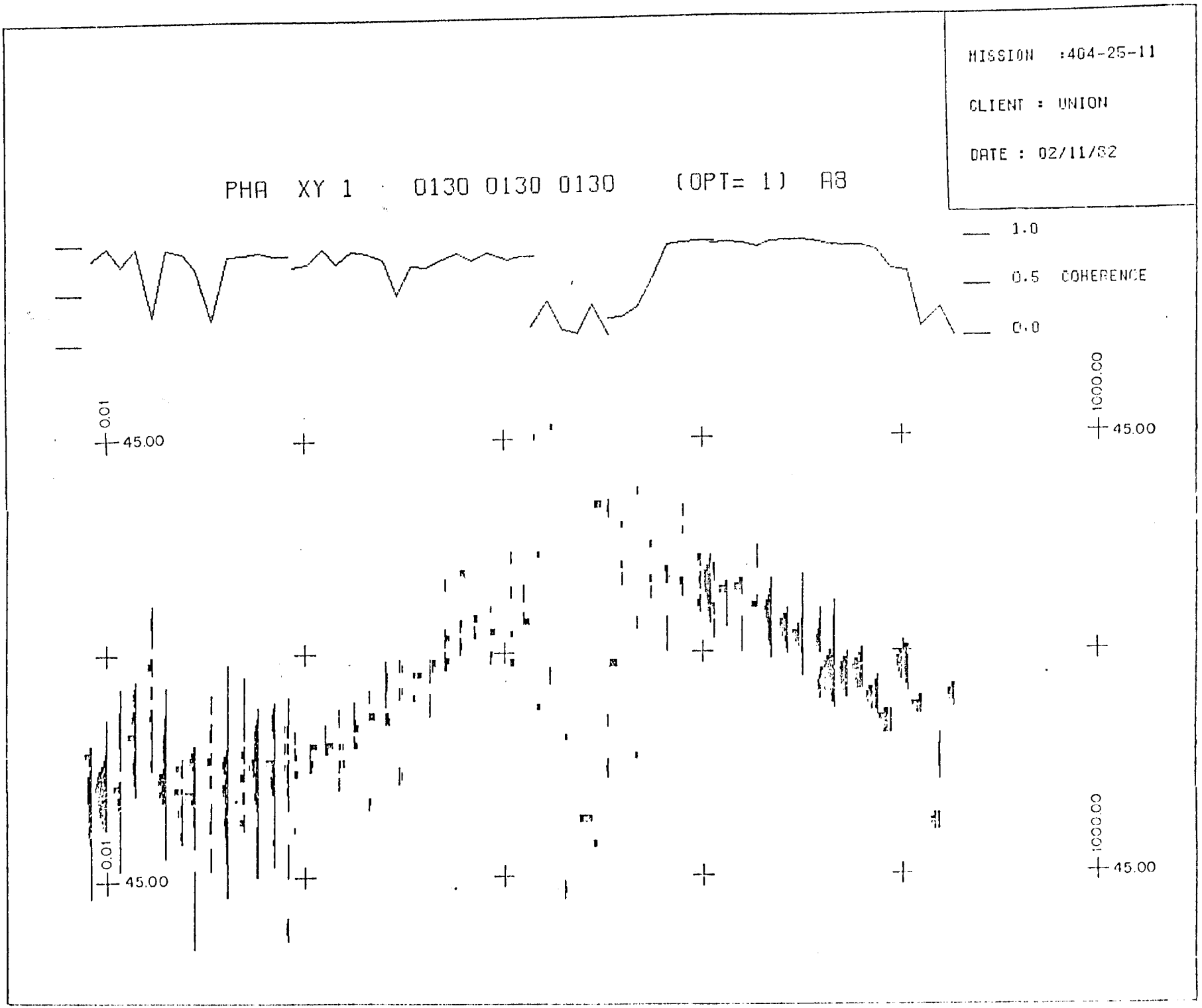
superficial inhomogeneity ?

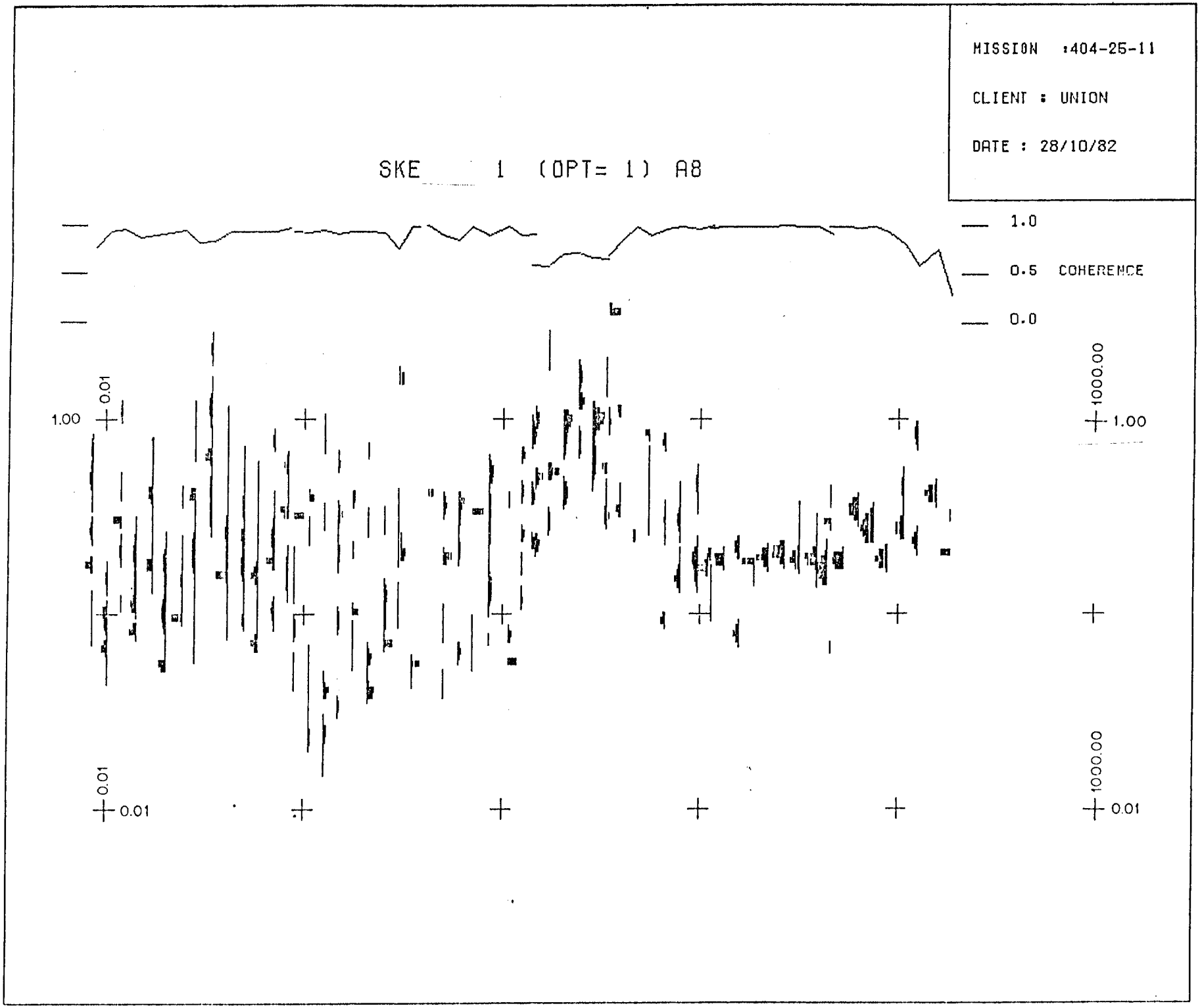

MISSION :1404-25-11
CLIENT : UNION
DATE : 26/10/82
RHO INV 1 (OPT= 1) A8
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

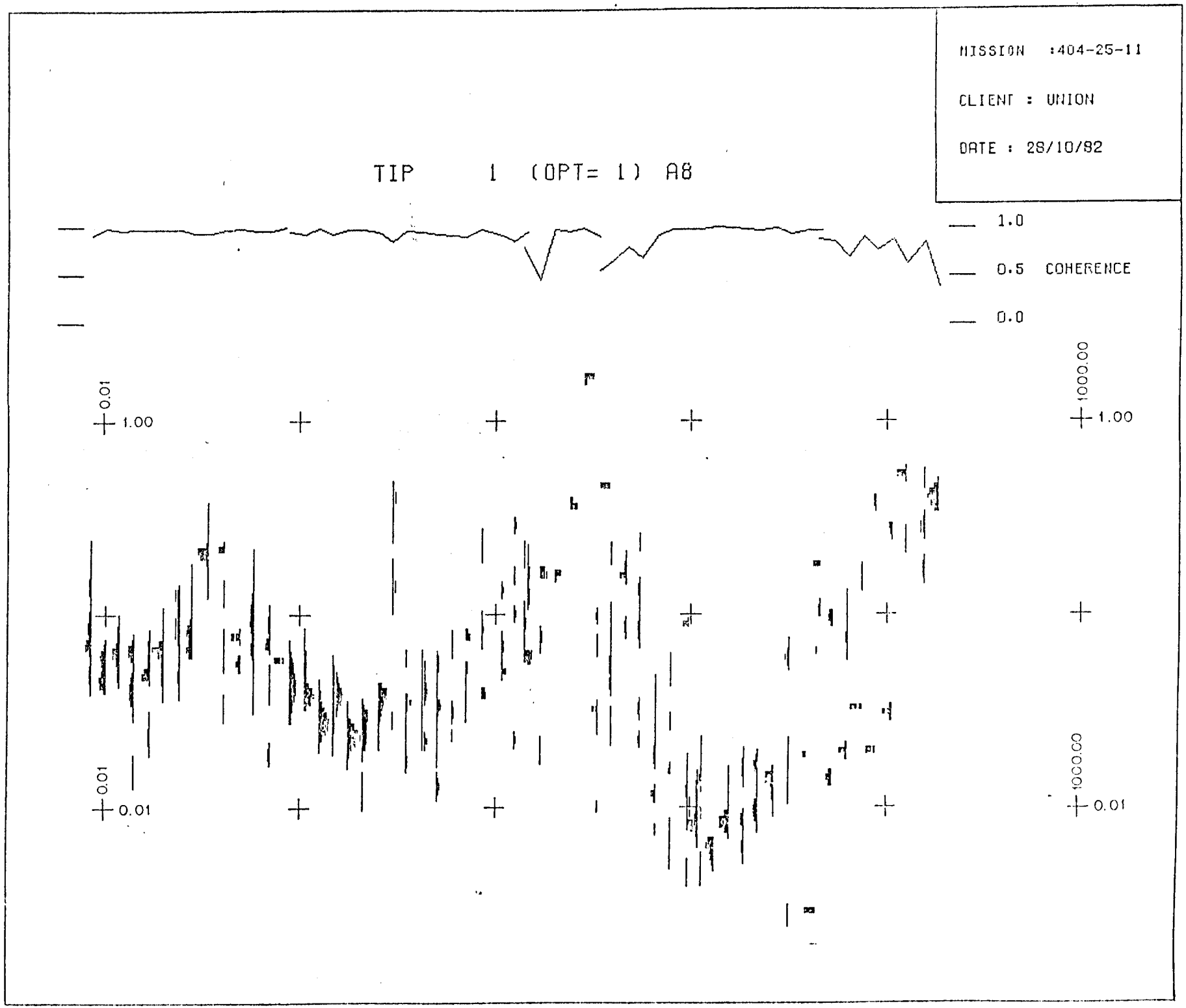

MISSION : 404-25-11
CLIENT : UNION
DATE : 03/11/82
RHO YX 1 0130 0130 0130 (OPT= 1) A8
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 02/11/82
PHA YX 1 0130 0130 0130 (OPT= 1) A8
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-26-11
CLIENT : UNION
DATE : 03/11/92
RHO XY 1 0130 0130 0130 (OPT= 1) A8
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 02/11/82
PHA XY 1 0130 0130 0130 (OPT= 1) A8
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 28/10/82
SKE 1 (OPT= 1) A8
1.0
0.5
COHERENCE
0.0
1000.00
1.00
0.01
1.00
0.01
0.01
1000.00
0.01

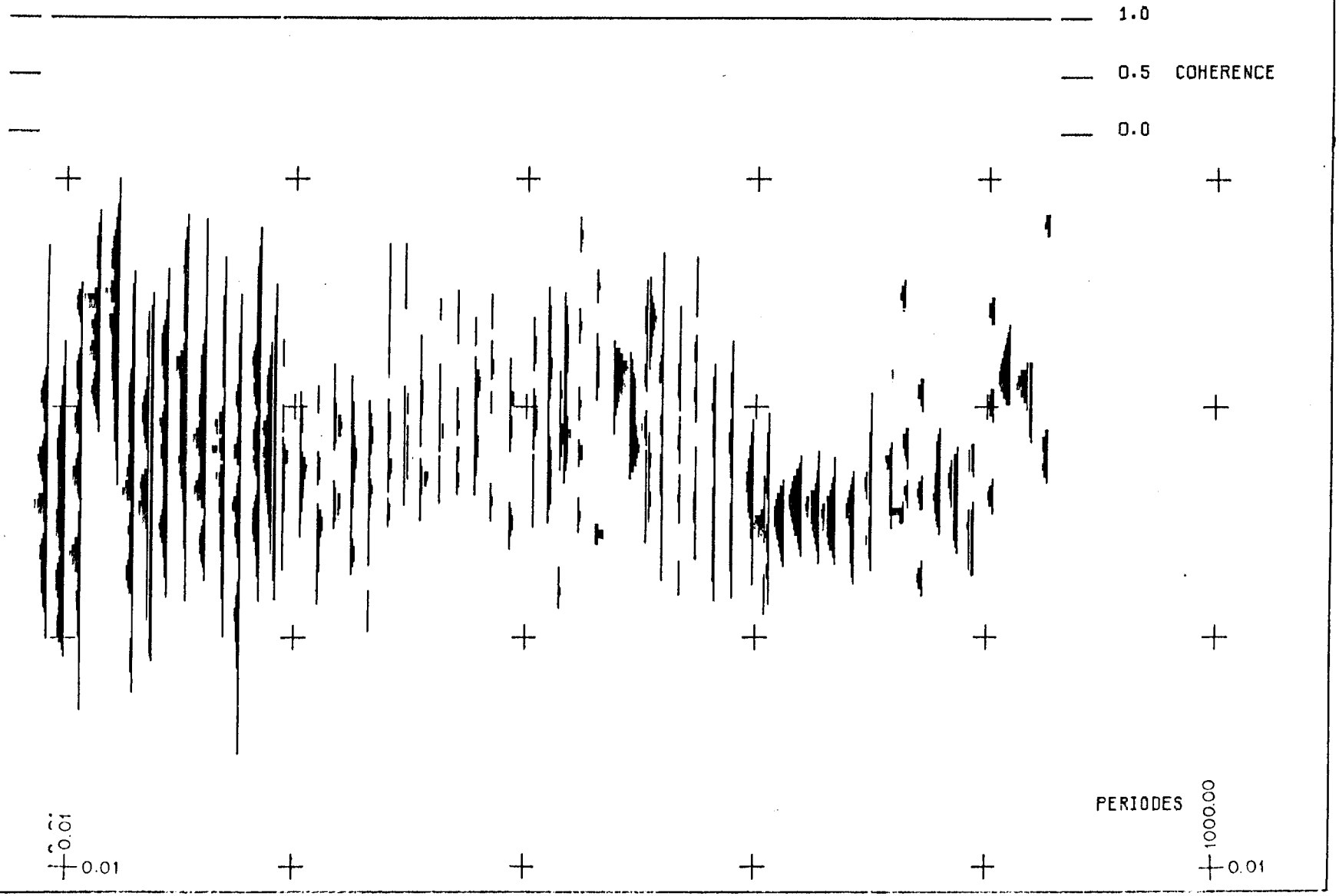

MISSION :404-25-11
CLIENT : UNION
DATE : 28/10/92
TIP 1 (OPT= 1) A8
1.0
0.5 COHERENCE
0.0
0.01
1.00
0.01
0.01
1000.00
1.00
1000.00
0.01

MISSION :404-25-11

CLIENT : UNION

DATE : 04/11/82

ELL 1 0130 0130 0130 (OPT= 1) A8



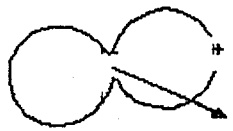
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 125DR
SKEW = 0.162
TIPPER = 0.077
COMBINAISON 1

MISSION : 604-25-11
CLIENT : ORION
DATE : 04/11/82

SKEW = 0.168
TIPPER = 0.078
COMBINAISON 2

XY

MODULE 3.136 VAL. CENTRALE 30. AZIMUT DU MINIMUM 353°
MAXI 80-2 ANG ROT (MINIMUM) 120°



XY

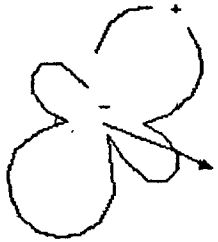
MODULE 3/126 VAL. CENTRALE 18. AZIMUT DU MINIMUM 353°
MAXI 84-2 ANG ROT (MINIMUM) 120°

XX

MODULE 0.781 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 343°
MAXI 14.780 ANG ROT (MINIMUM) 130°

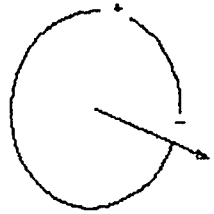
XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 343°
MAXI 14.78 ANG ROT (MINIMUM) 130°



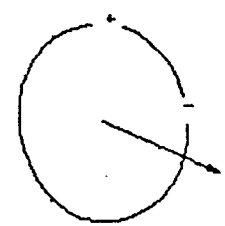
YZ

MODULE 3.196 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 13°
MAXI 0.068 ANG ROT (MAXIMUM) 100°



YZ

MODULE 3.196 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 3°
MAXI 0.087 ANG ROT (MAXIMUM) 110°



STATION A8
DOMAINE NF
DECOUPAGE KEN Z4
TMIN = 0.10
TMAX = 0:60
AZIMUT EX 125DR
SKEW = 0.105
TIPPER = 0.167
COMBINAISON 1

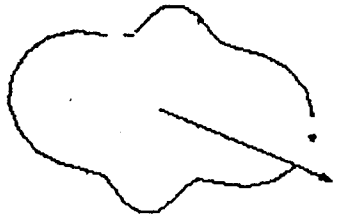
SKEW = 0.082
TIPPER = 0.162
COMBINAISON 2

XY

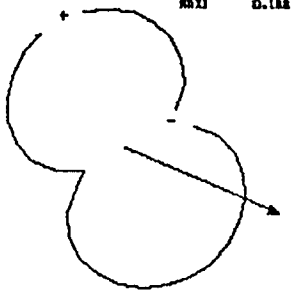
XY

XX

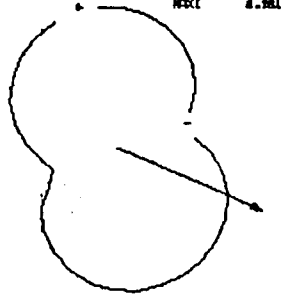
XX



YZ



YZ



STATION HO
DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 125°
SKEW = 0.032
TIPPER = 0.228
COMBINAISON 1

SKEW = 0.035
TIPPER = 0.216
COMBINAISON 2

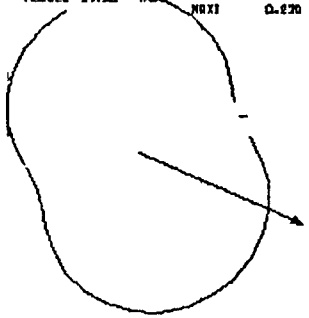
XY

XY

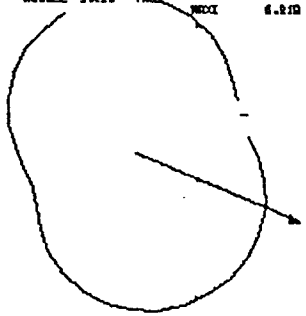
XX

XX

YZ



YZ



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 9

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/17 | 23 | B | 22 | B | 64 | A-B |
| | 26 | A | 25 | A | | |

| | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| FIELD ARRAY | Ex | 130 | 117 = 117°E |
| | Ey | 30 | 27 = 27°E |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 23°W | 50 | 67° = 67°E | YX | XY |
| | | 0 (HF) | 117° = 117°E | | |
| STRIKE from Hz | 13°W | | | | |

## COMMENTS

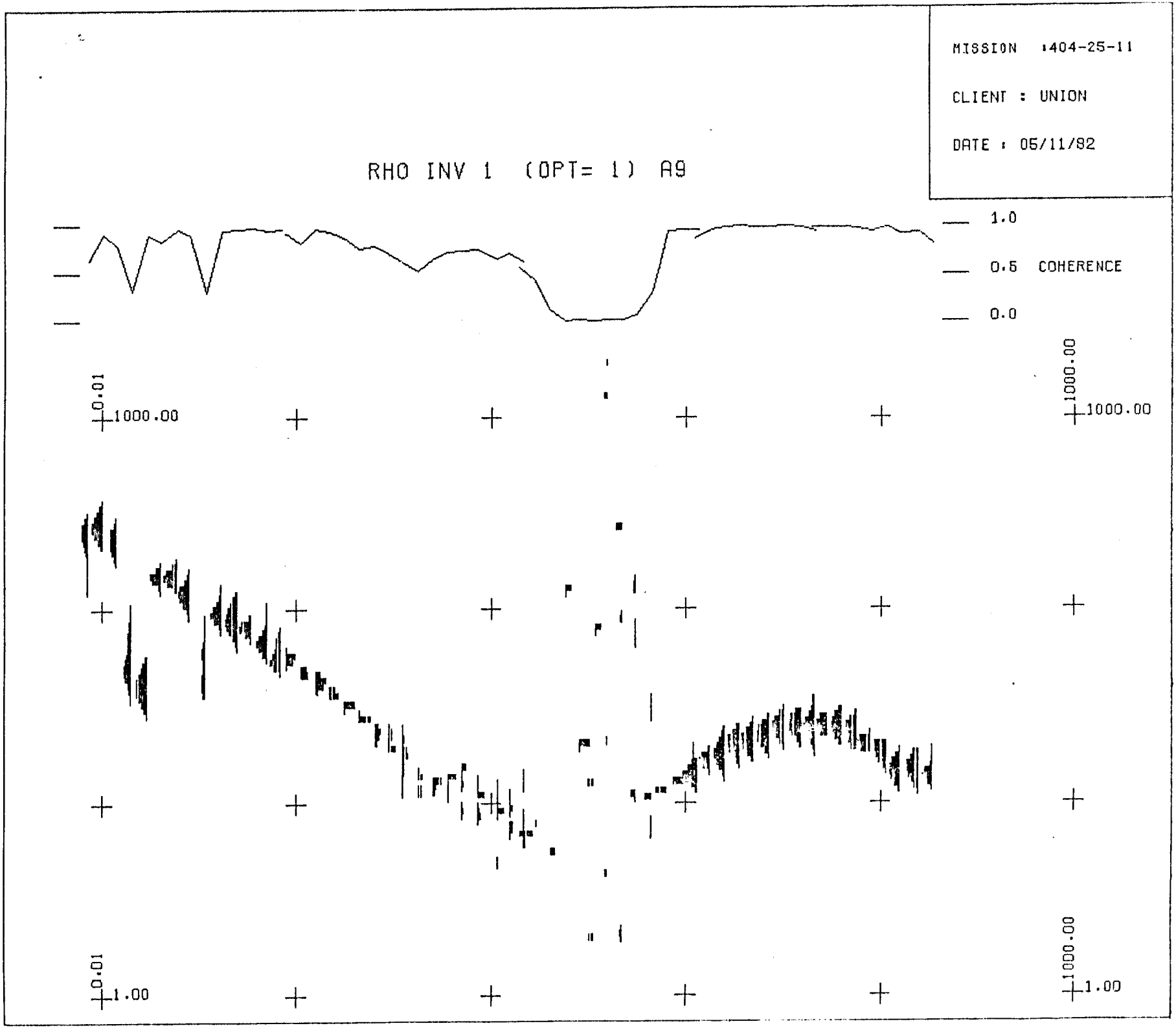
### FIELD

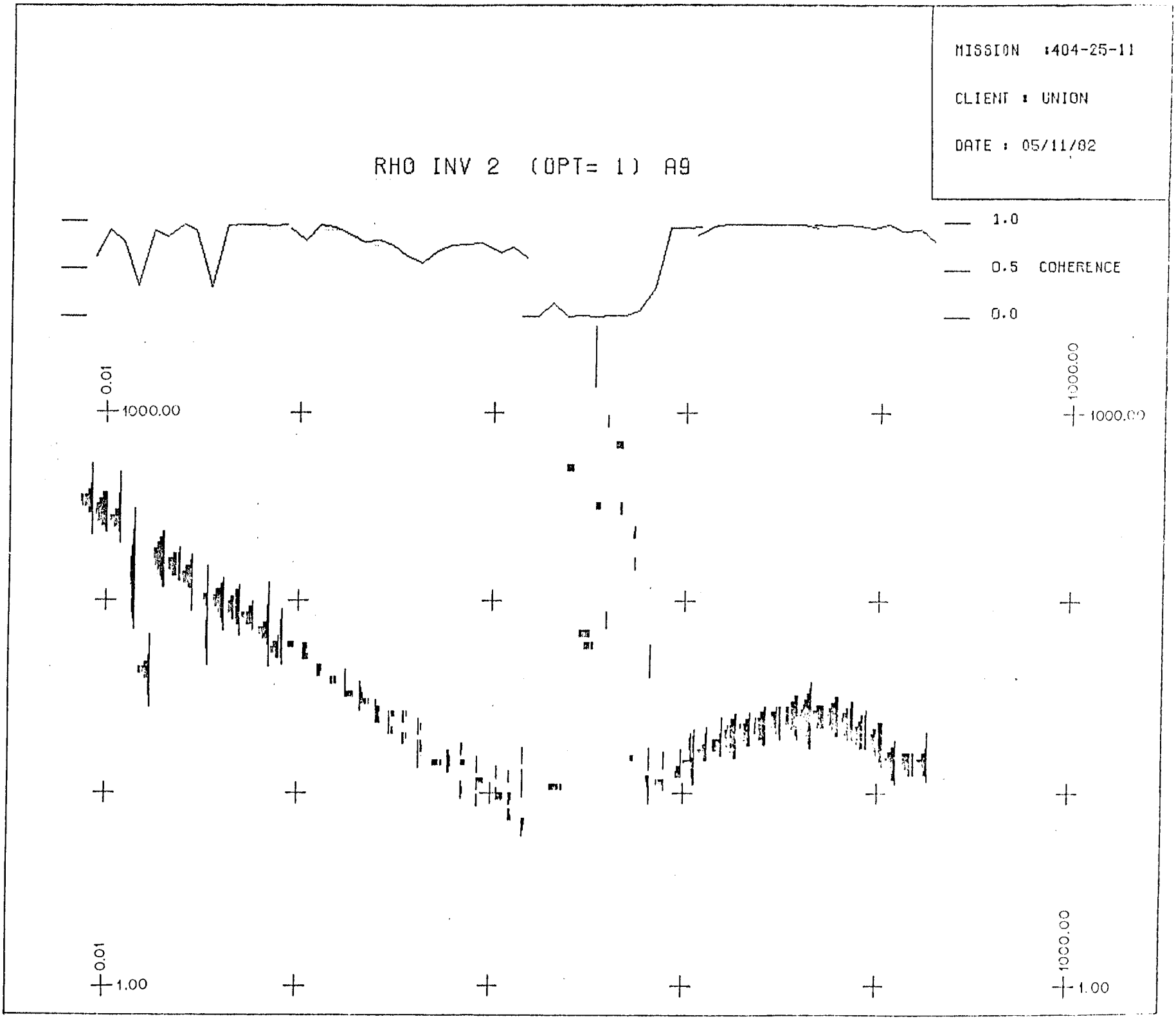
no clouds - light wind
light thunderstorm

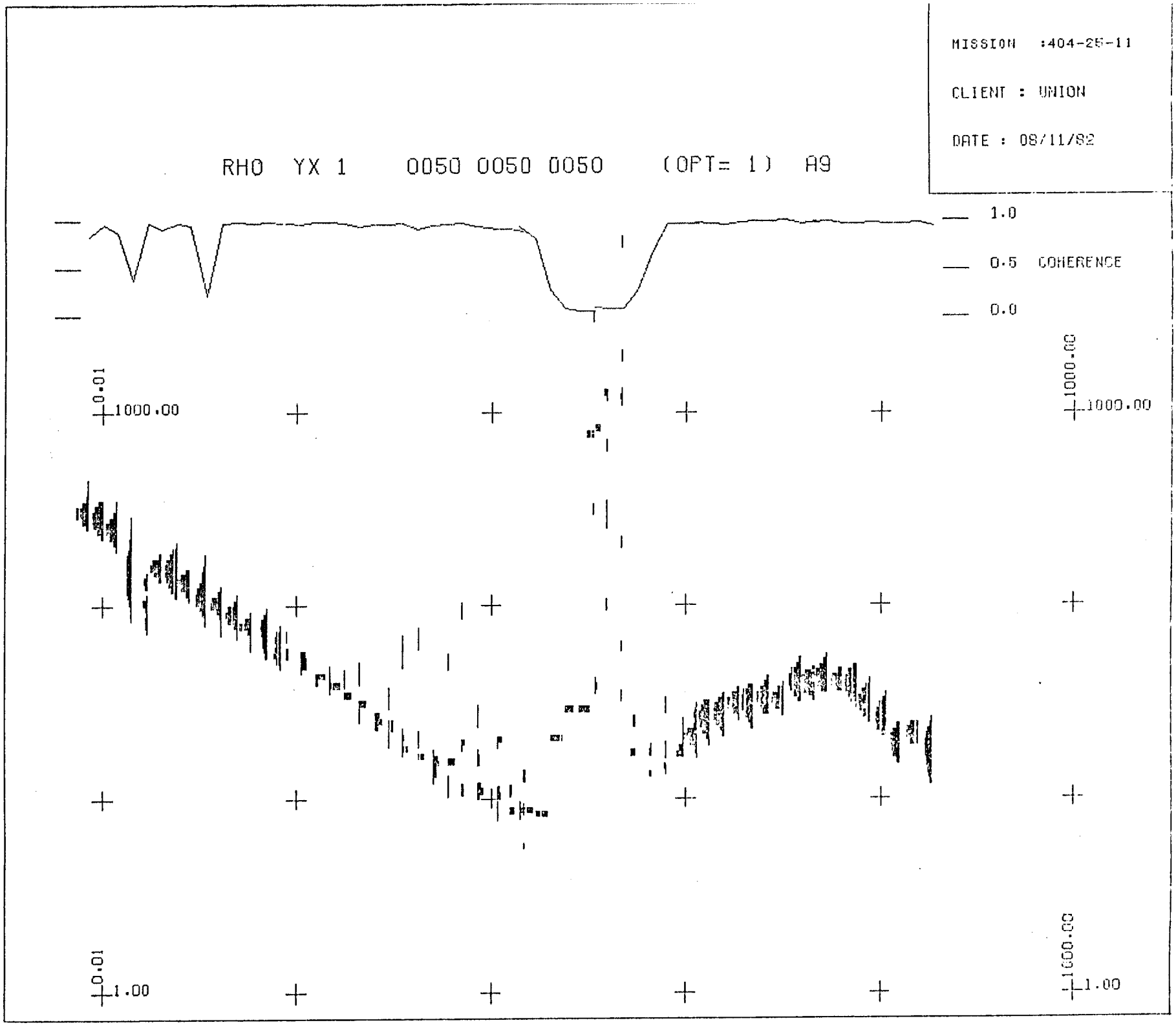
### PROCESSING

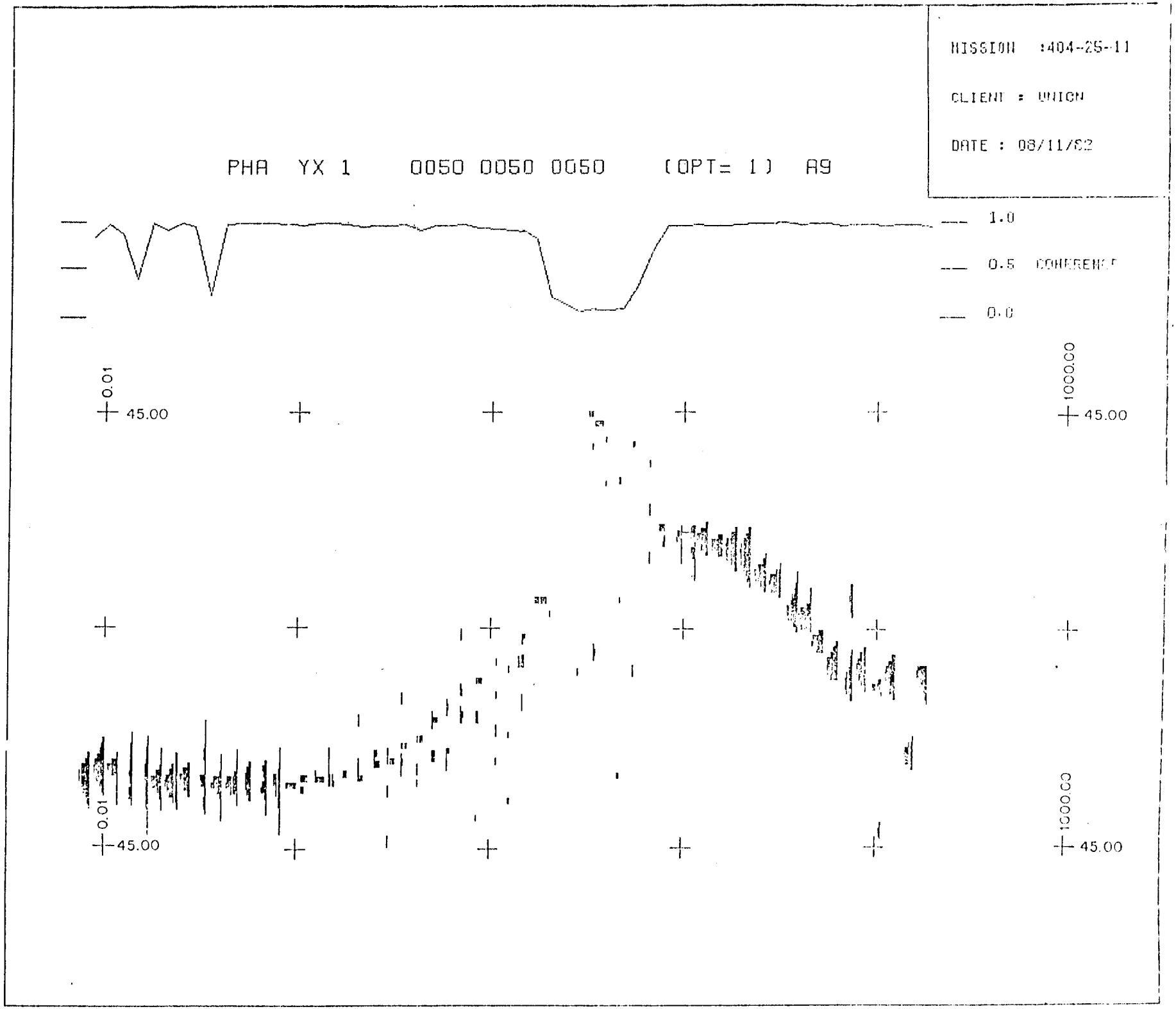
Fair

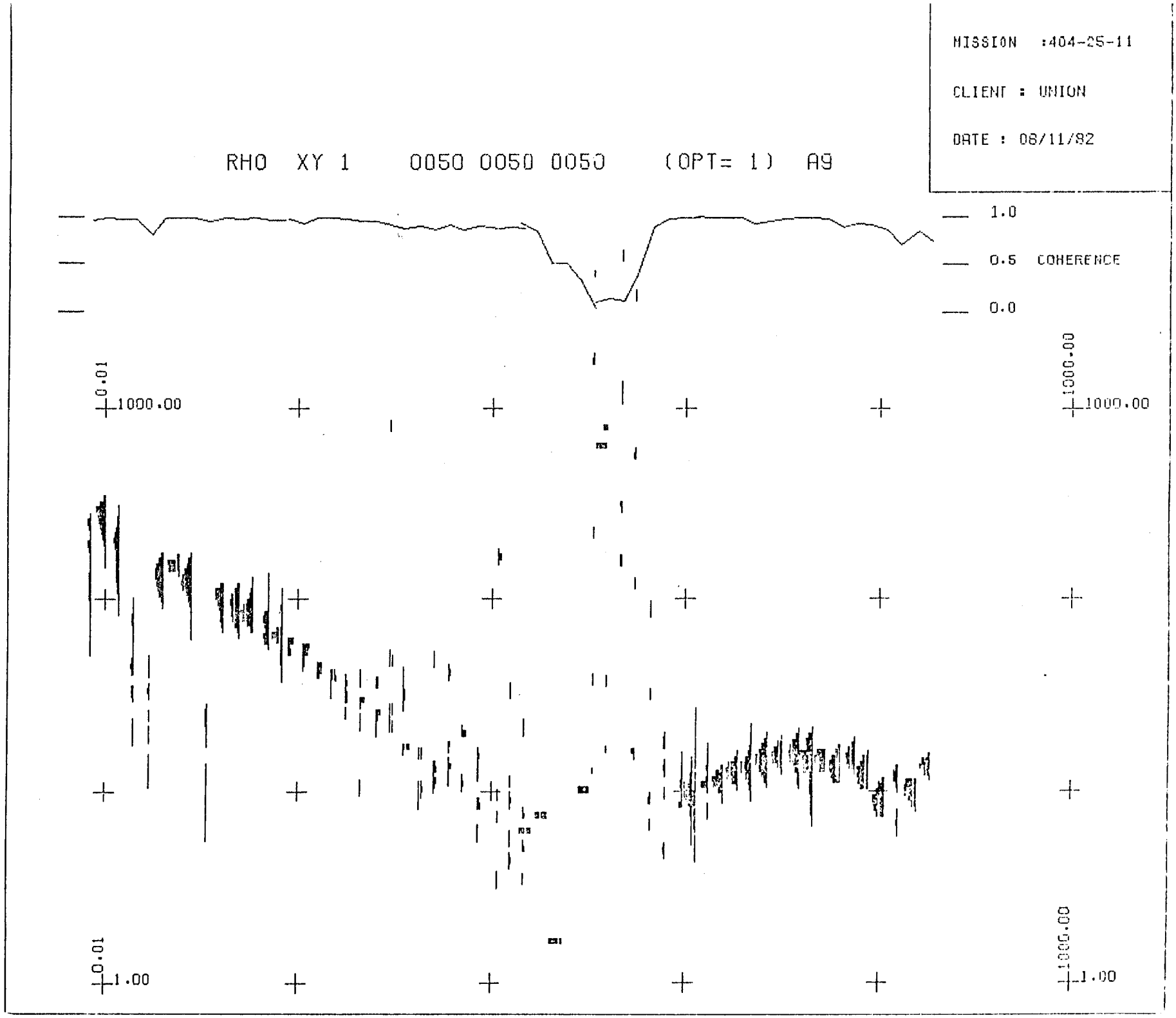
HF: $\rho E \# \rho H$
LF: $\rho E > \rho H$

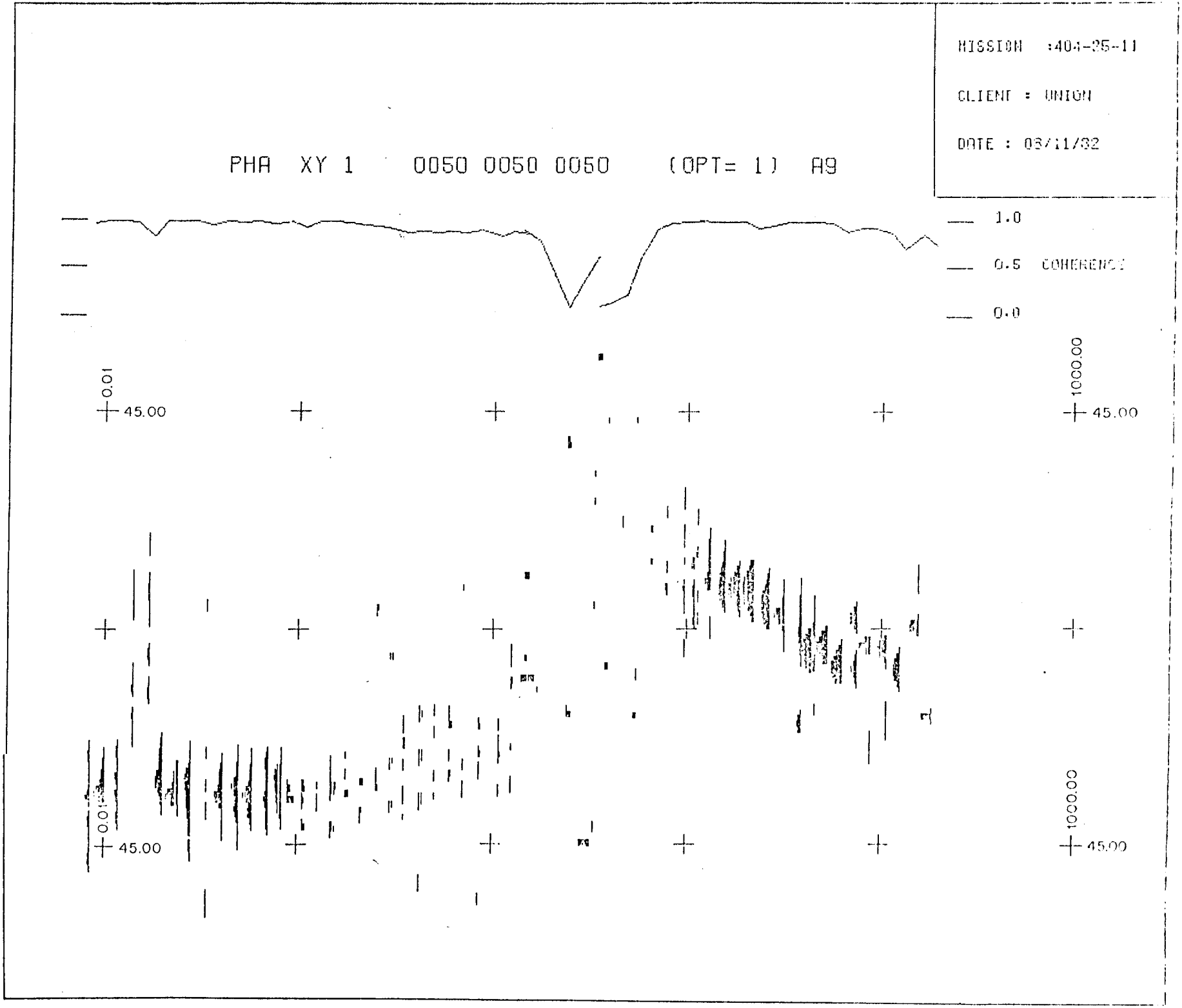

MISSION :404-25-11
CLIENT : UNION
DATE : 05/11/82
RHO INV 1 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

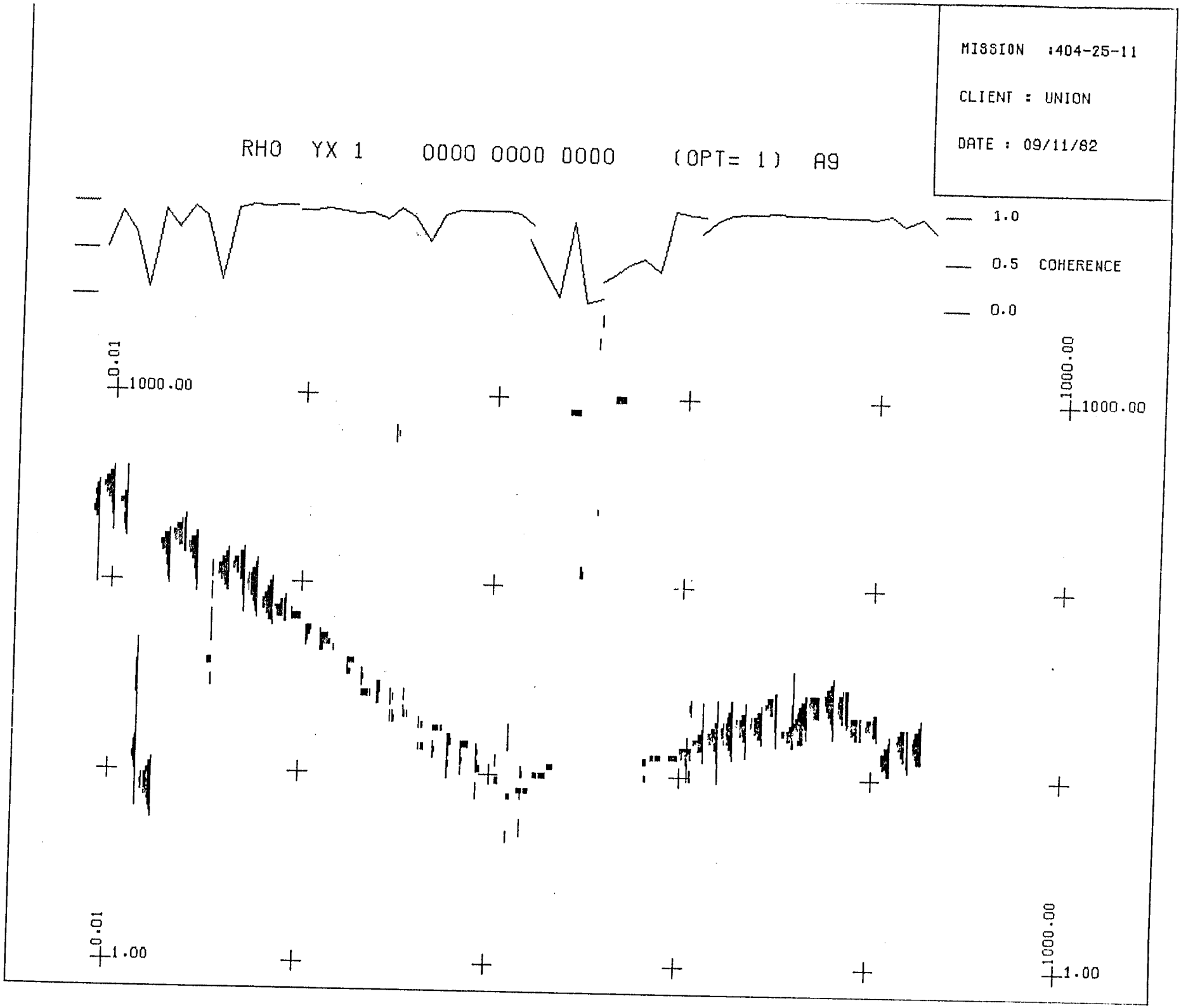

MISSION :404-25-11
CLIENT : UNION
DATE : 05/11/82
RHO INV 2 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

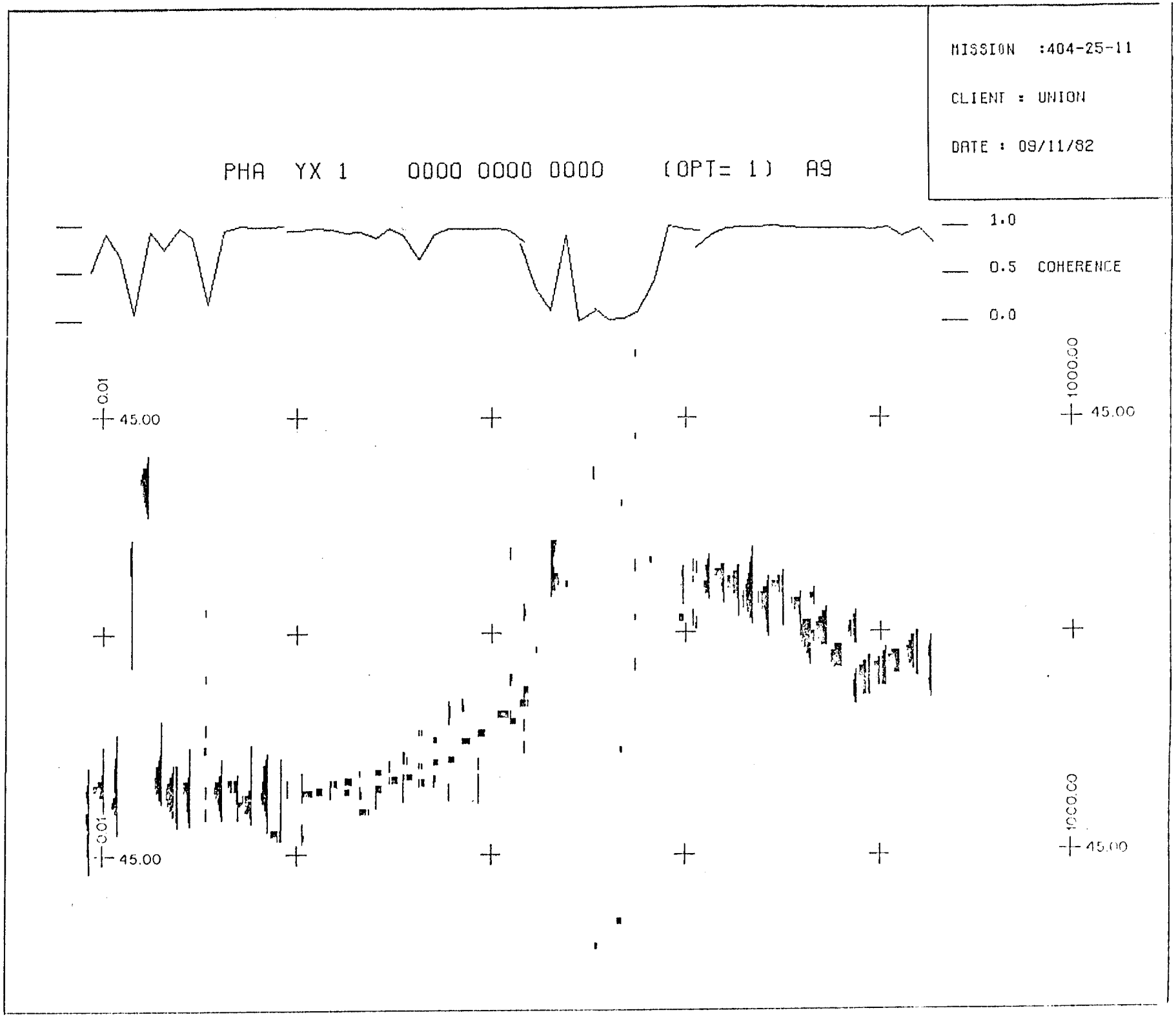

MISSION :404-25-11
CLIENT : UNION
DATE : 08/11/82
RHO YX 1 0050 0050 0050 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

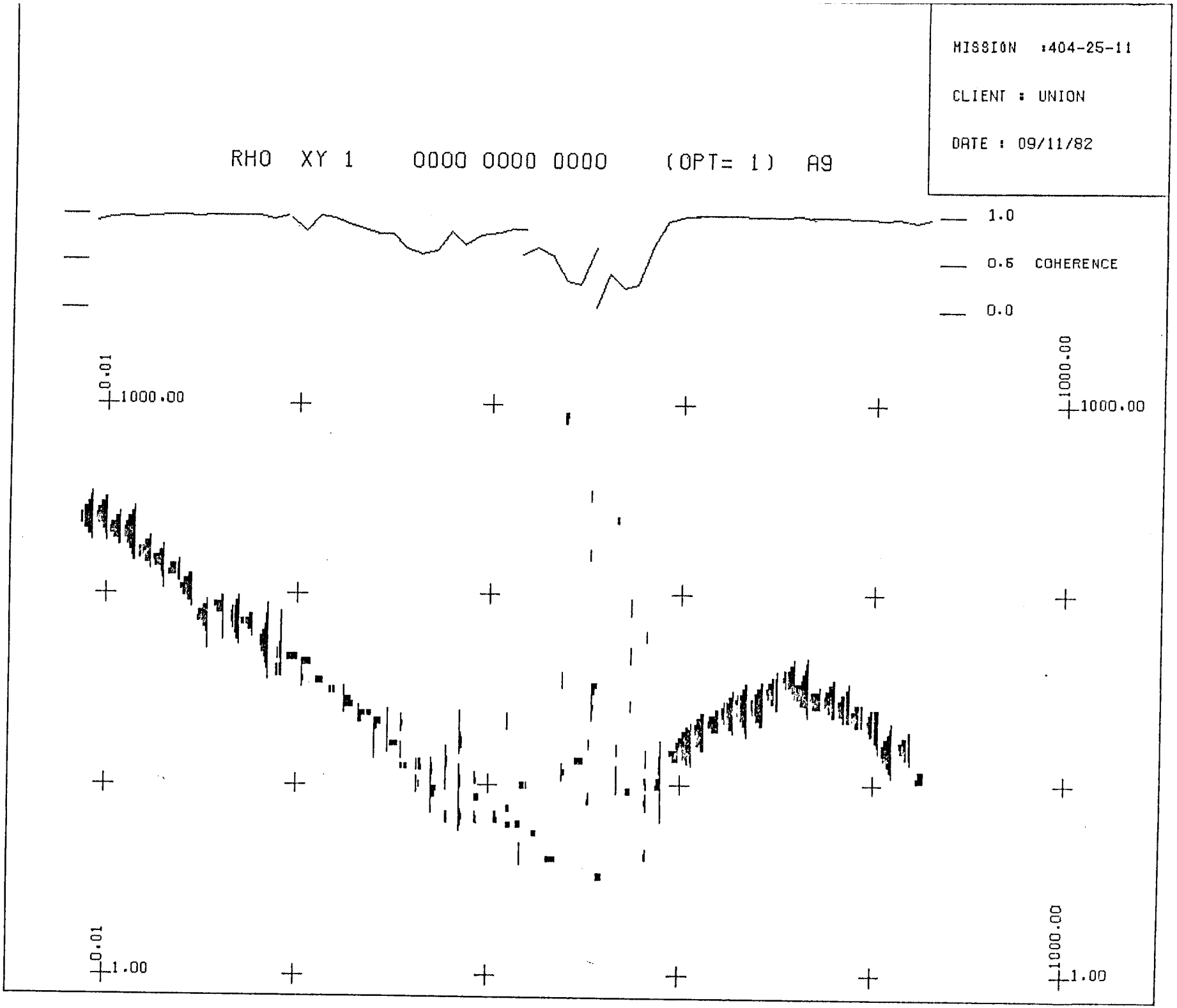

MISSION :404-25-11
CLIENT : UNION
DATE : 08/11/82
PHA YX 1 0050 0050 0050 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

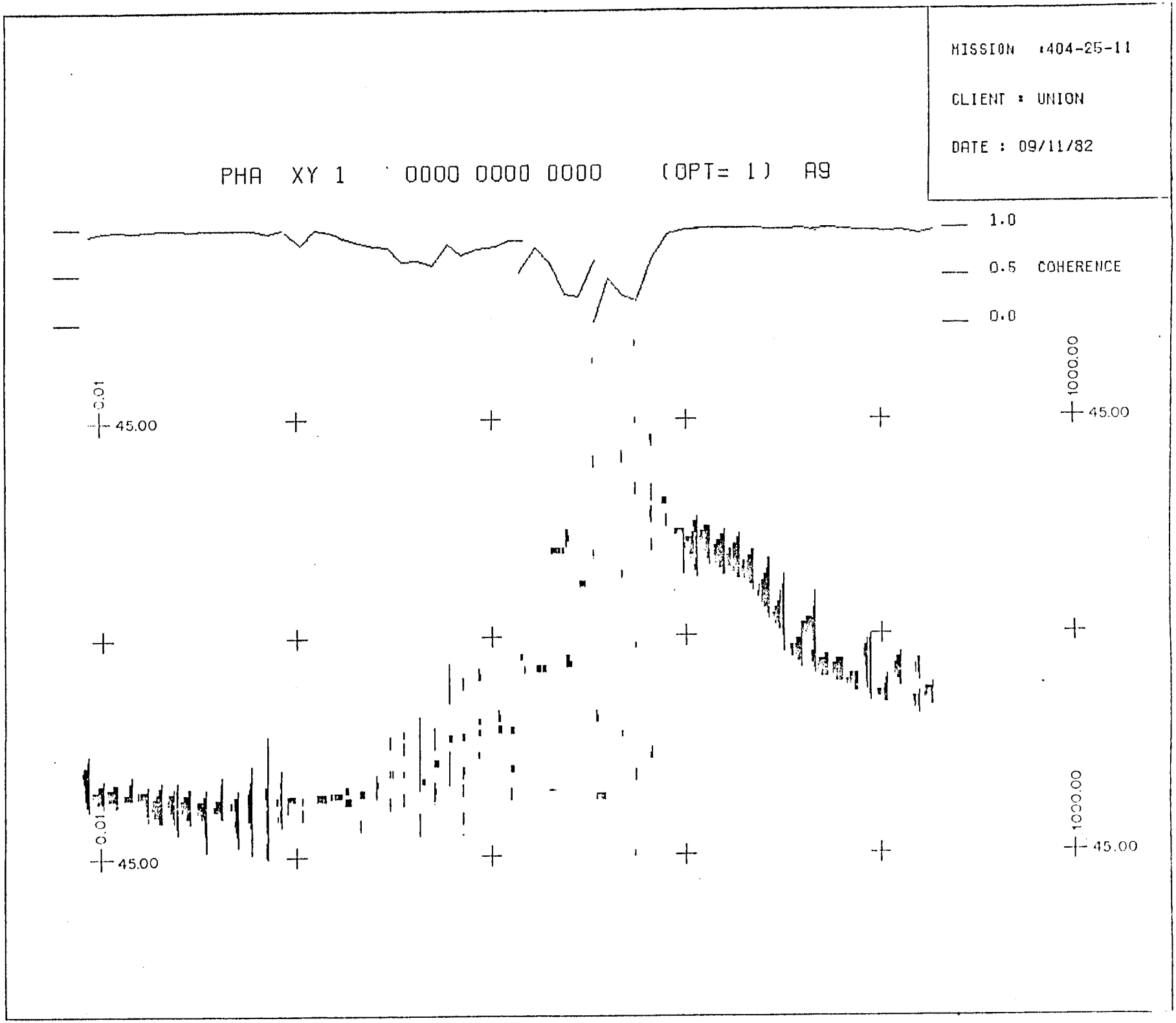

MISSION :404-25-11
CLIENT : UNION
DATE : 08/11/82
RHO XY 1 0050 0050 0050 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1.00

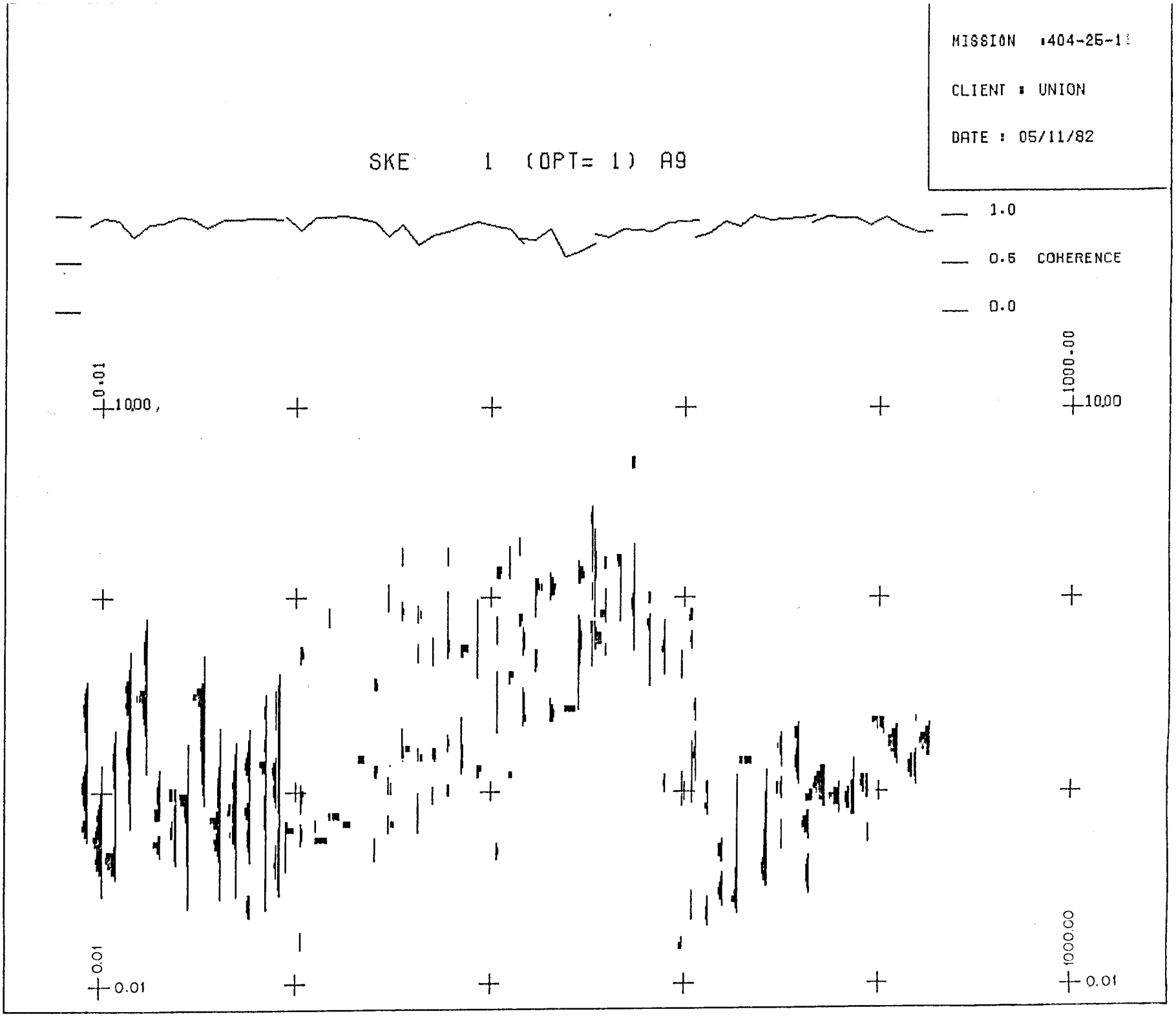

MISSION :404-25-11
CLIENT : UNION
DATE : 03/11/32
PHA XY 1 0050 0050 0050 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

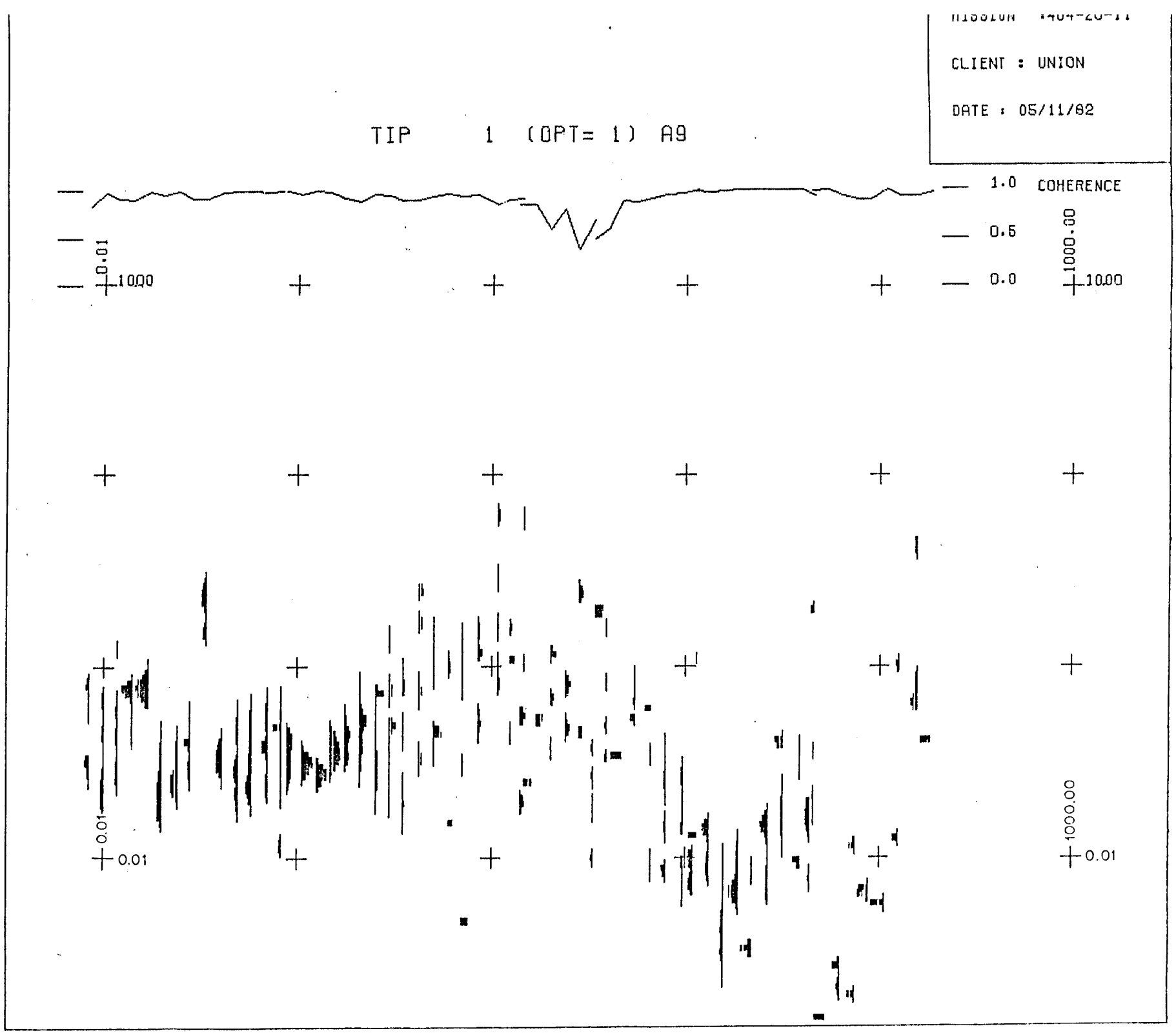

MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
RHO YX 1 0000 0000 0000 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

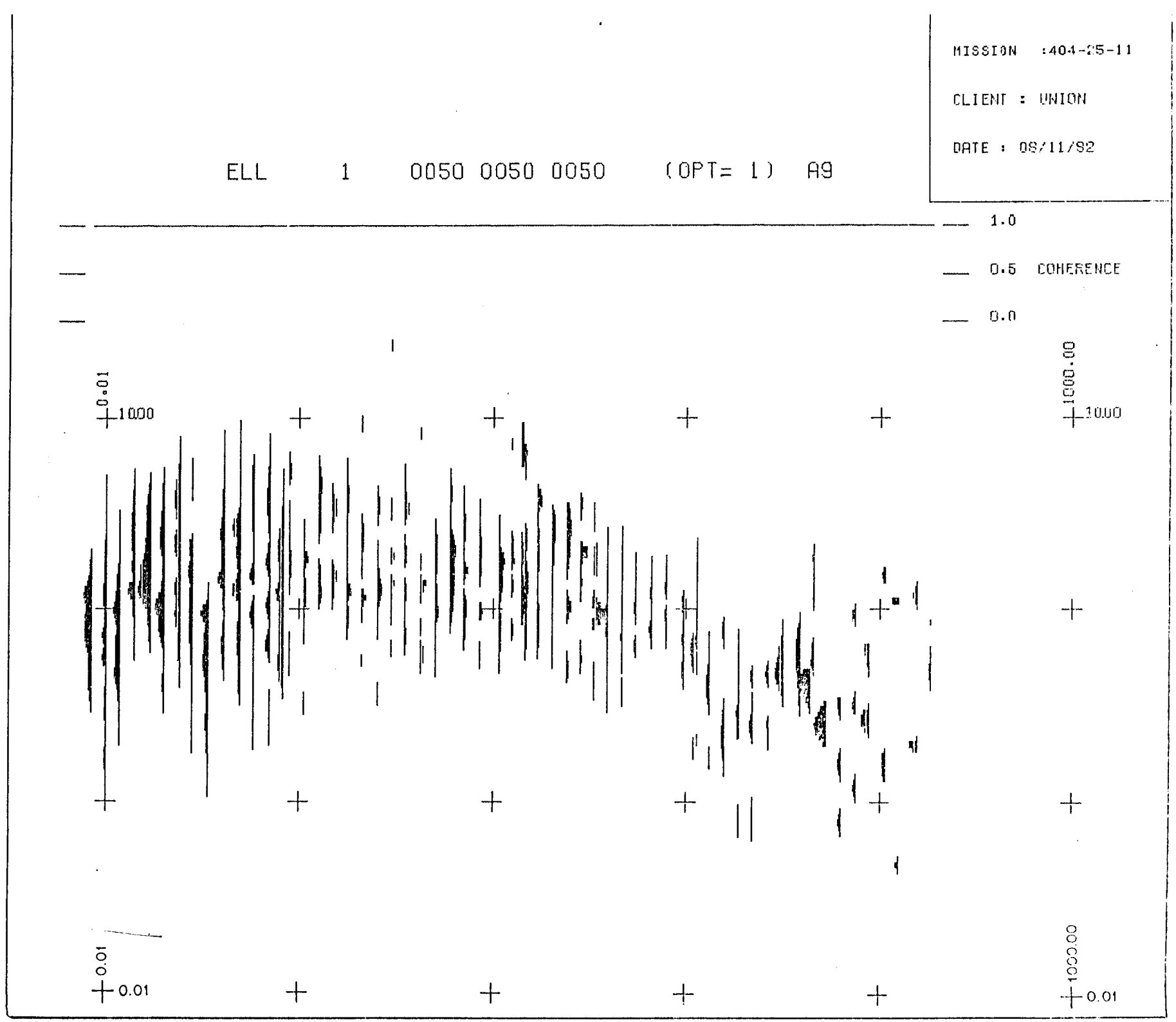

MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
PHA YX 1 0000 0000 0000 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

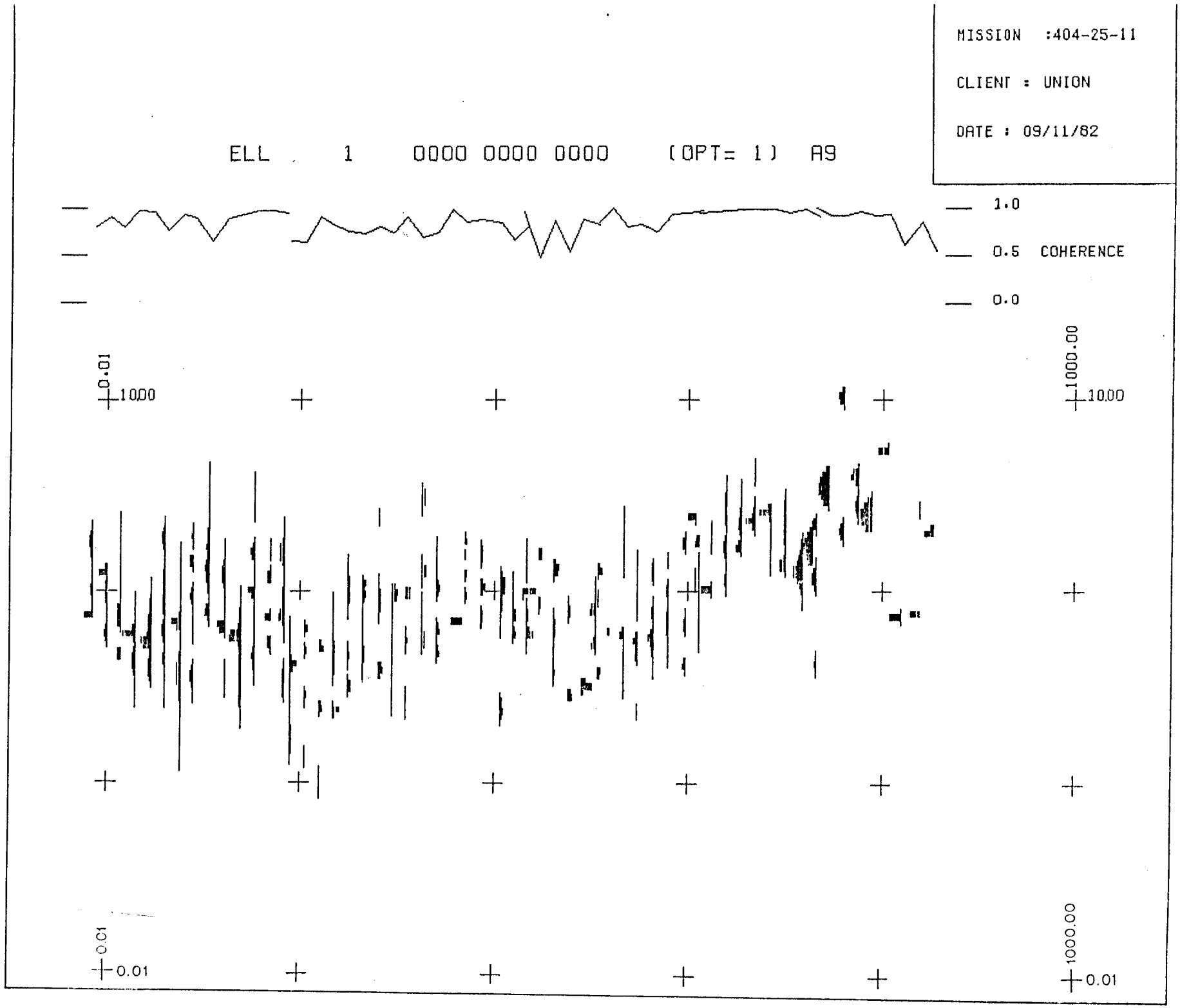

MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
RHO XY 1 0000 0000 0000 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
PHA XY 1 0000 0000 0000 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-1
CLIENT : UNION
DATE : 05/11/82
SKE 1 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
10,00
1000.00
10,00
0.01
1000.00
0.01
0.01


CLIENT : UNION
DATE : 05/11/02
TIP 1 (OPT= 1) A9
1.0
COHERENCE
0.5
0.0
0.01
10.00
1000.00
10.00
0.01
0.01
1000.00
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 08/11/82
ELL 1 0050 0050 0050 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
1000
0.01
0.01
1000.00
10.00
1000.00
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
ELL 1 0000 0000 0000 (OPT= 1) A9
1.0
0.5 COHERENCE
0.0
0.01
1000
0.01
1000.00
10.00
0.01
0.01
1000.00
0.01

STATION A9
DOMAINE BF
DECOUPAGE EN IZ
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 130m
SKEW = 0.008
TIPPER = 0.075
COMBINAISON 1

MISSION : 604-25-41
CLIENT : UNION
DATE : 06/11/83

SKEW = 0.016
TIPPER = 0.073
COMBINAISON 2

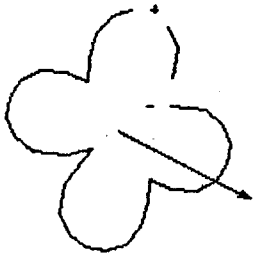
XY

MODULE 3.135 VAL. CENTRALE 30. AZIMUT DU MINIMUM 57°
MAXI 27.8 AMP RAT (MINIMUM) 80°

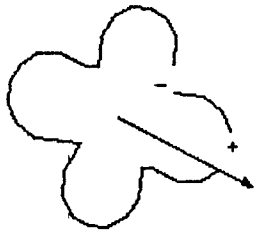
MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 57°
MAXI 26.1 AMP RAT (MINIMUM) 90°

XX

MODULE 1.592 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 57°
MAXI 3.124 AMP RAT (MINIMUM) 80°



MODULE 1.592 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 57°
MAXI 1.818 AMP RAT (MINIMUM) 90°



YZ

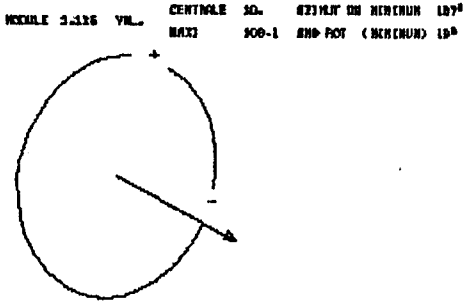
MODULE 3.195 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 317°
MAXI 8.878 AMP RAT (MAXIMUM) 150°

MODULE 3.105 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 347°
MAXI 8.874 AMP RAT (MAXIMUM) 138°

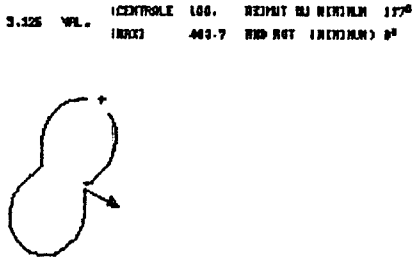
STATION A9
DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 130gm
SKEW = 0.049
TIPPER = 0.180
COMBINAISON 1

SKEW = 0.138
TIPPER = 0.165
COMBINAISON 2

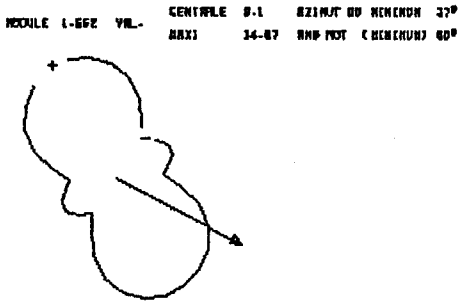
XY



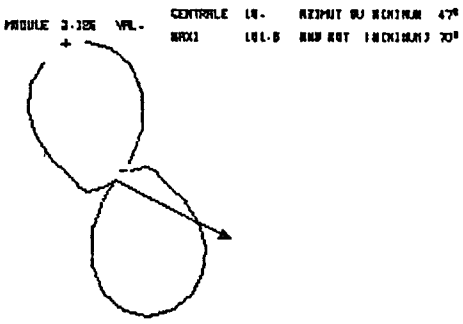
XY



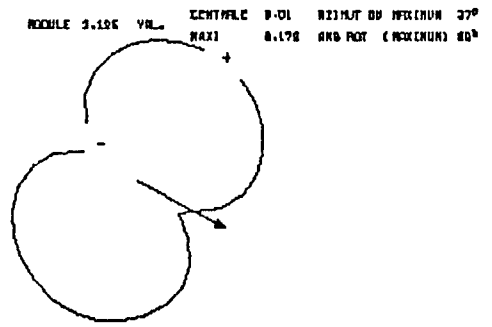
XX



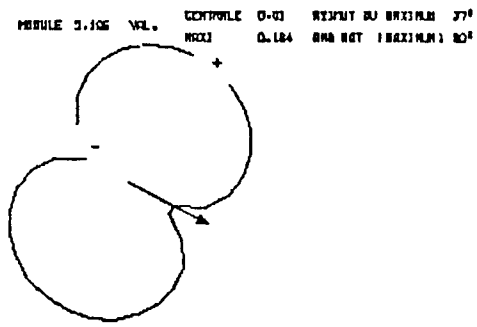
XX



YZ



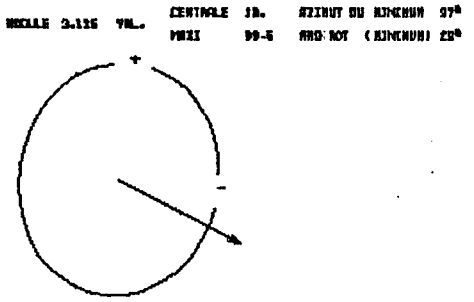
YZ



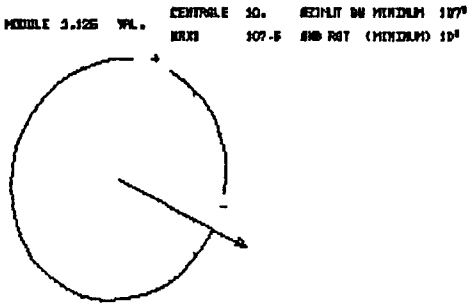
STATION A9
DOMAINE HF
DECOUPAGE EN 58
TMIN = 0.04
TMAX = 0.00
AZIMUT EX 130°
SKEW = 0.053
TIPPER = 0.181
COMBINAISON 1

SKEW = 0.050
TIPPER = 0.170
COMBINAISON 2

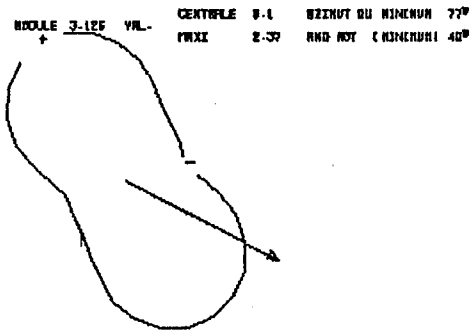
XY



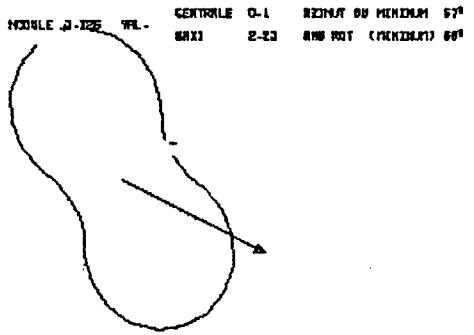
XY



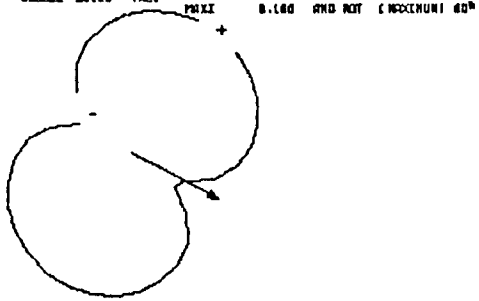
XX



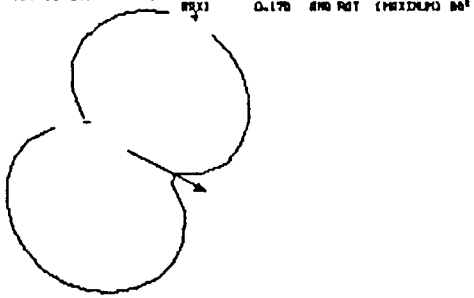
XX



YZ



YZ



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 10

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/17 | 28 | A | 27 | A | 29 | A-B |
| | 31 | B | 30 | A | | |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 330 | 297 = 63°W |
| | Ey | 230 | 207 = 153°W |

| STRIKE from Exy, Hxy | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| | 67°E | 50 | 247 = 67°E | XY | YX |
| | | 20 (HF) | 277 = 83°W | | |
| STRIKE from Hz | 47°E | | | | |

## COMMENTS

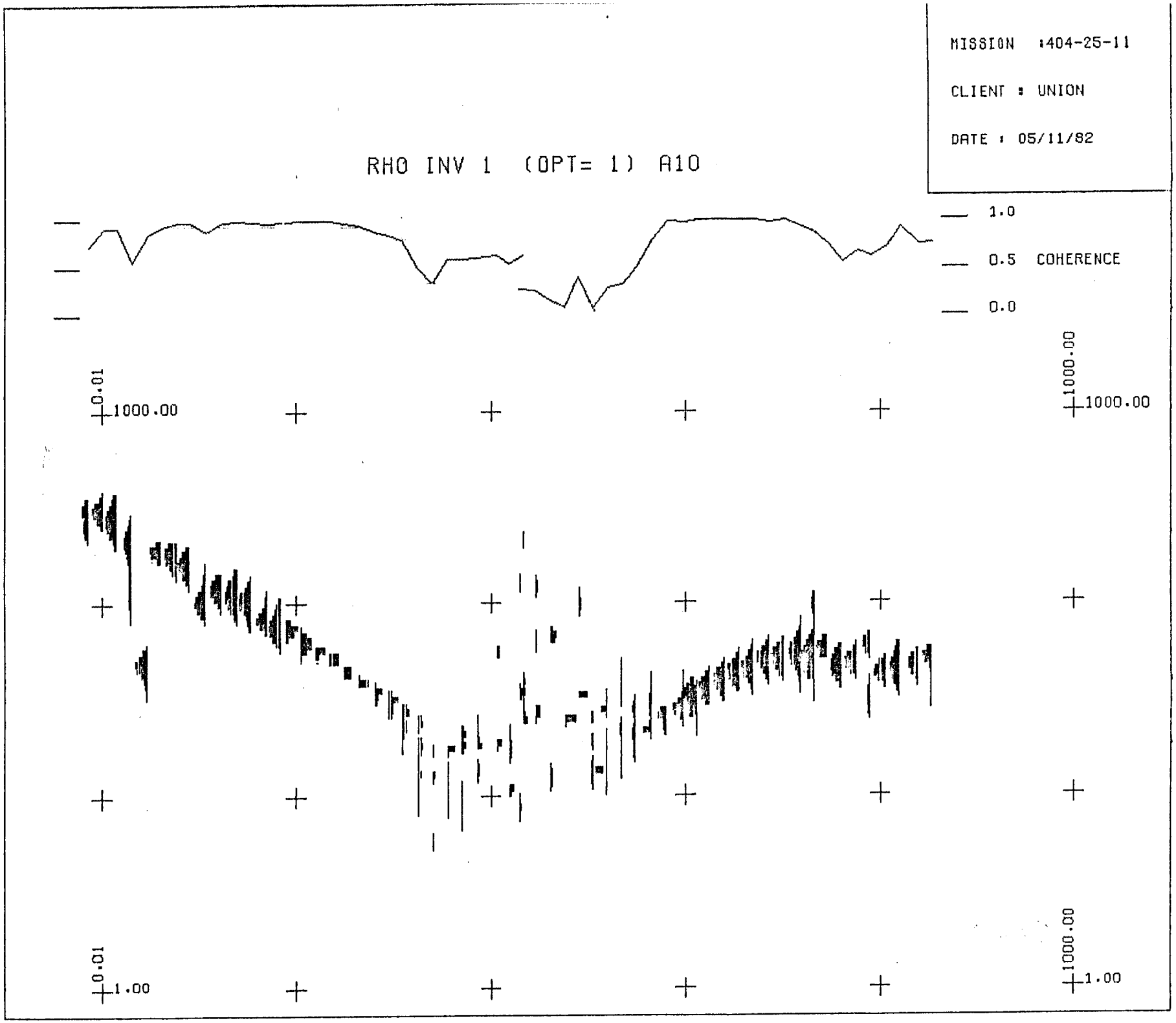
### FIELD

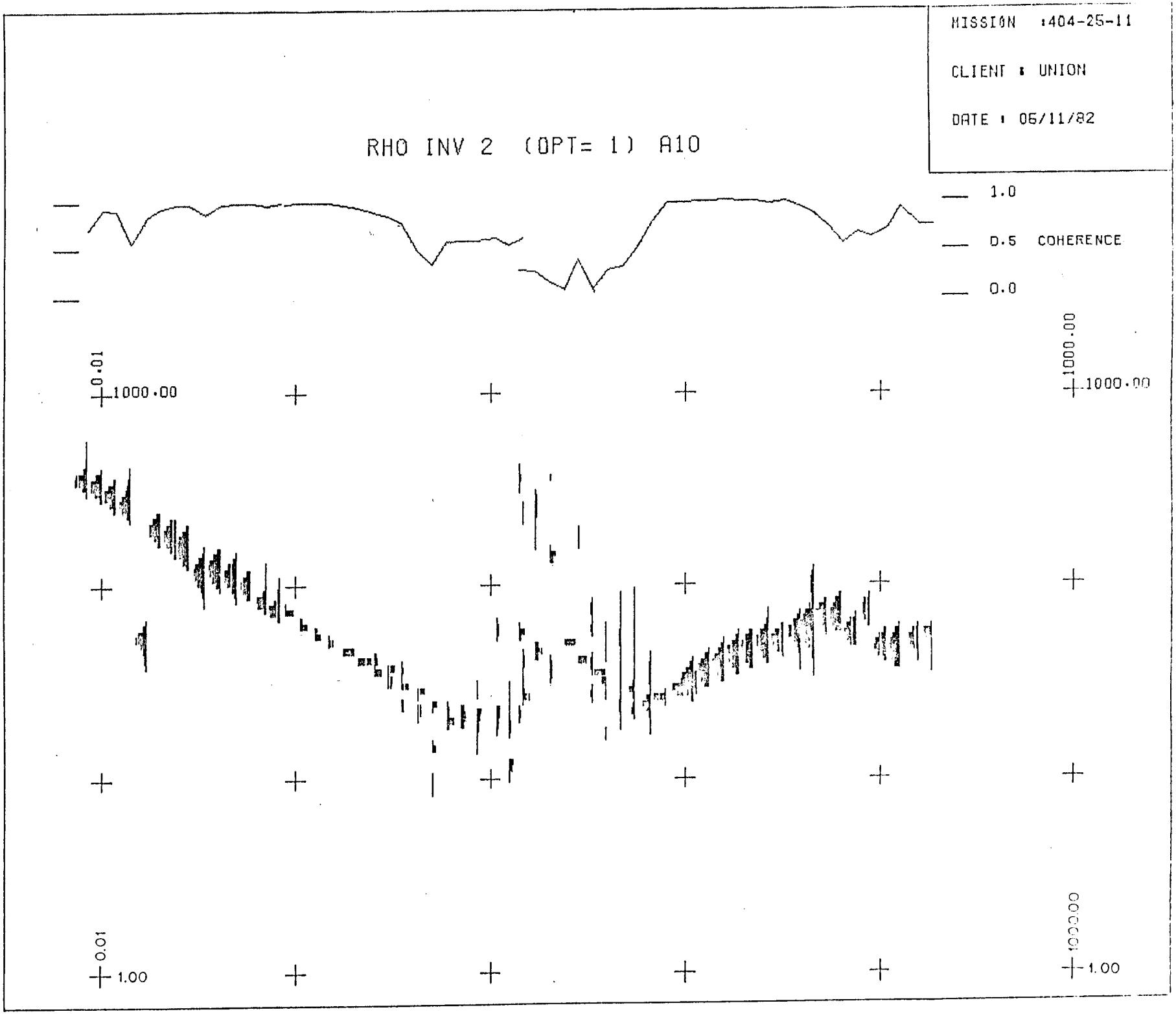
no clouds
light wind

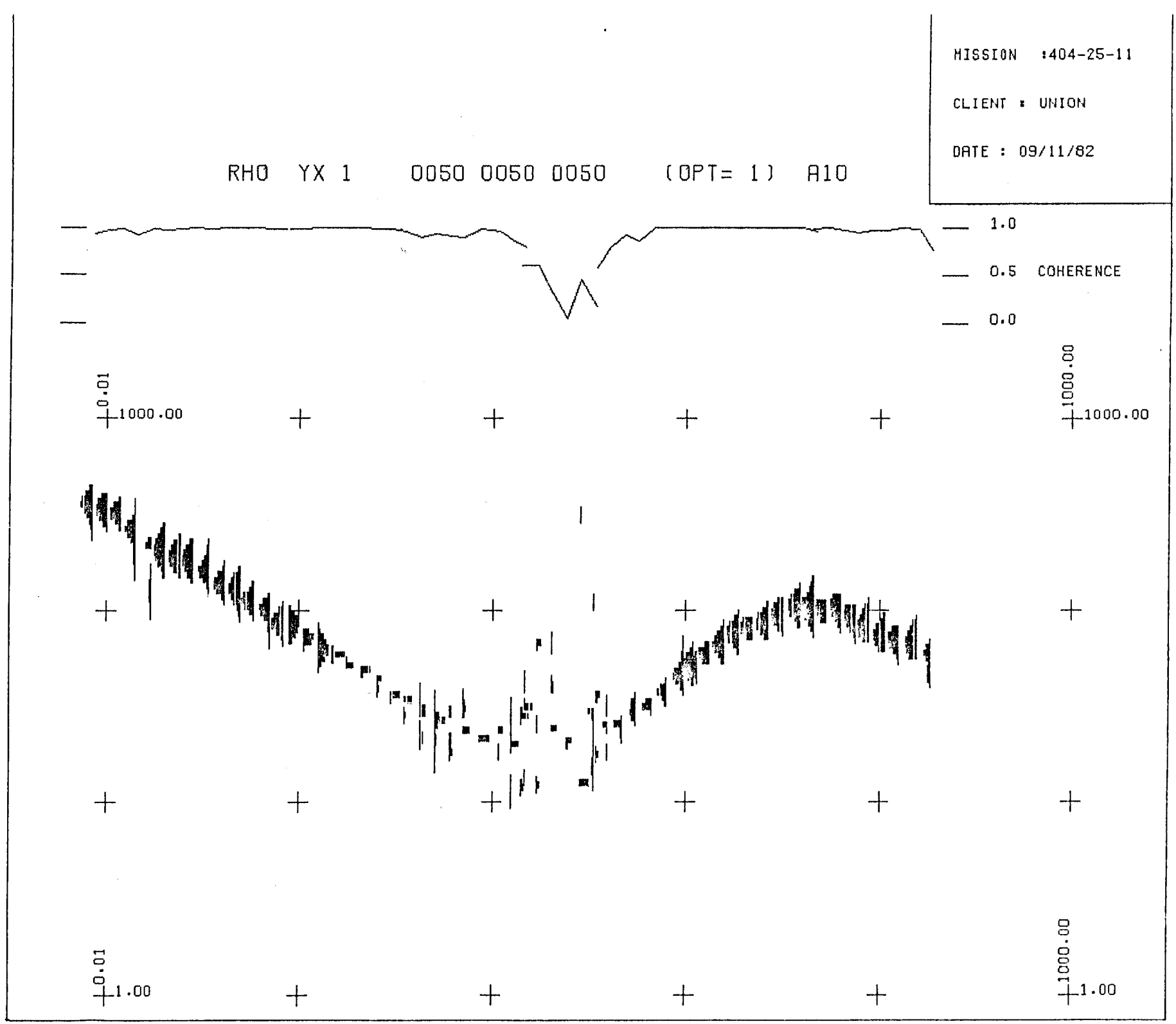
### PROCESSING

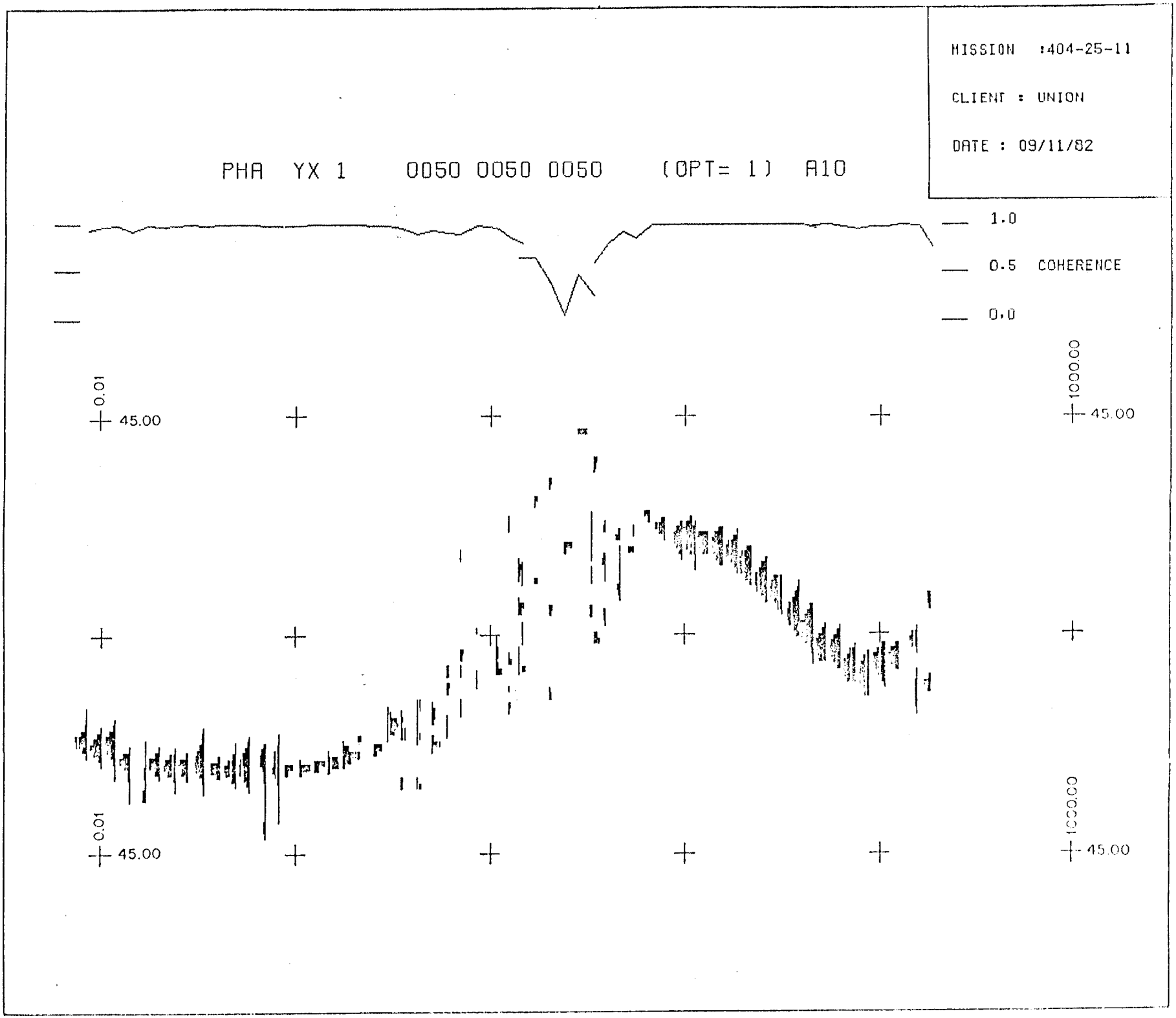
Fair

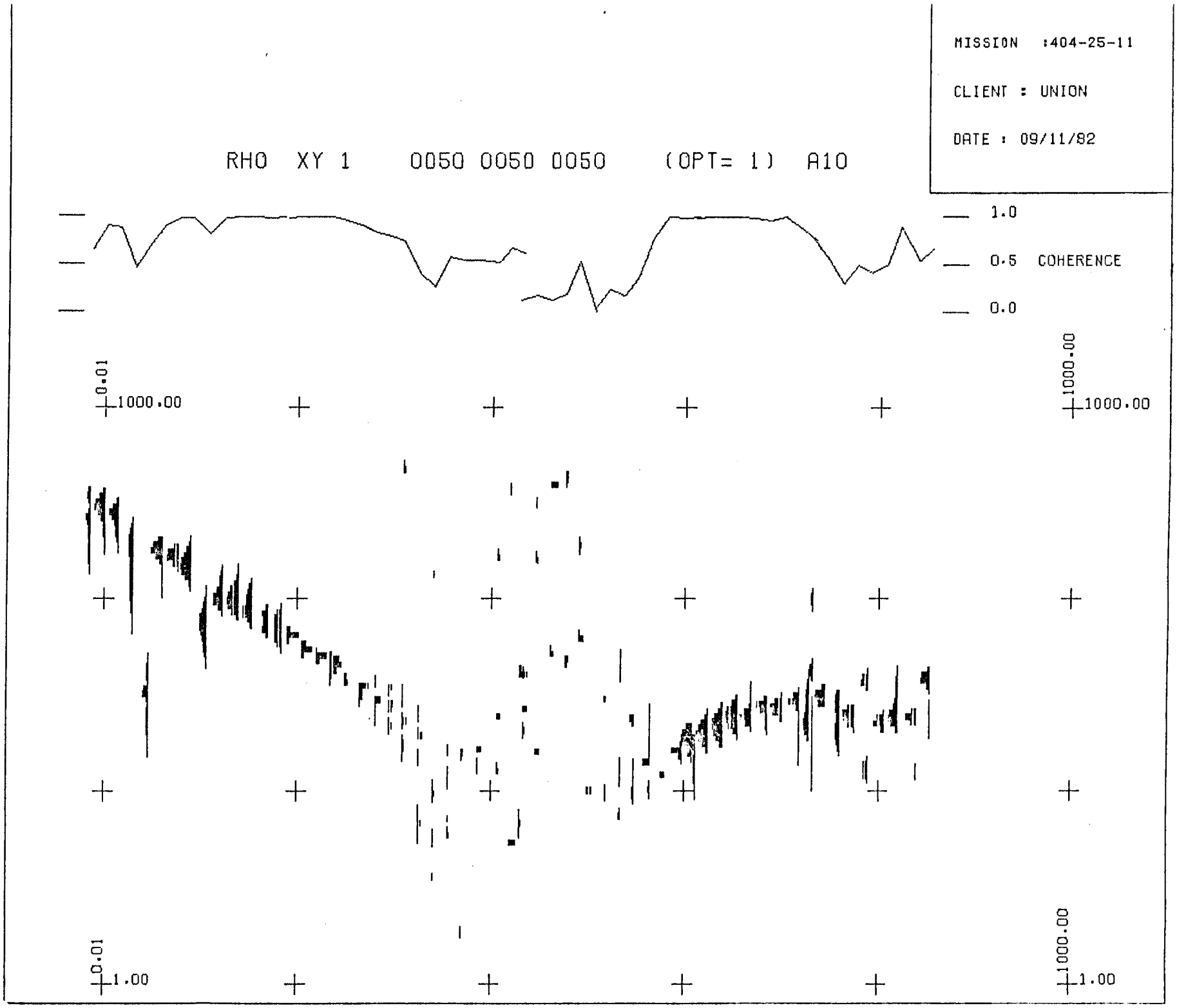
HF: ≠ strike
LF: $\rho E < \rho H$

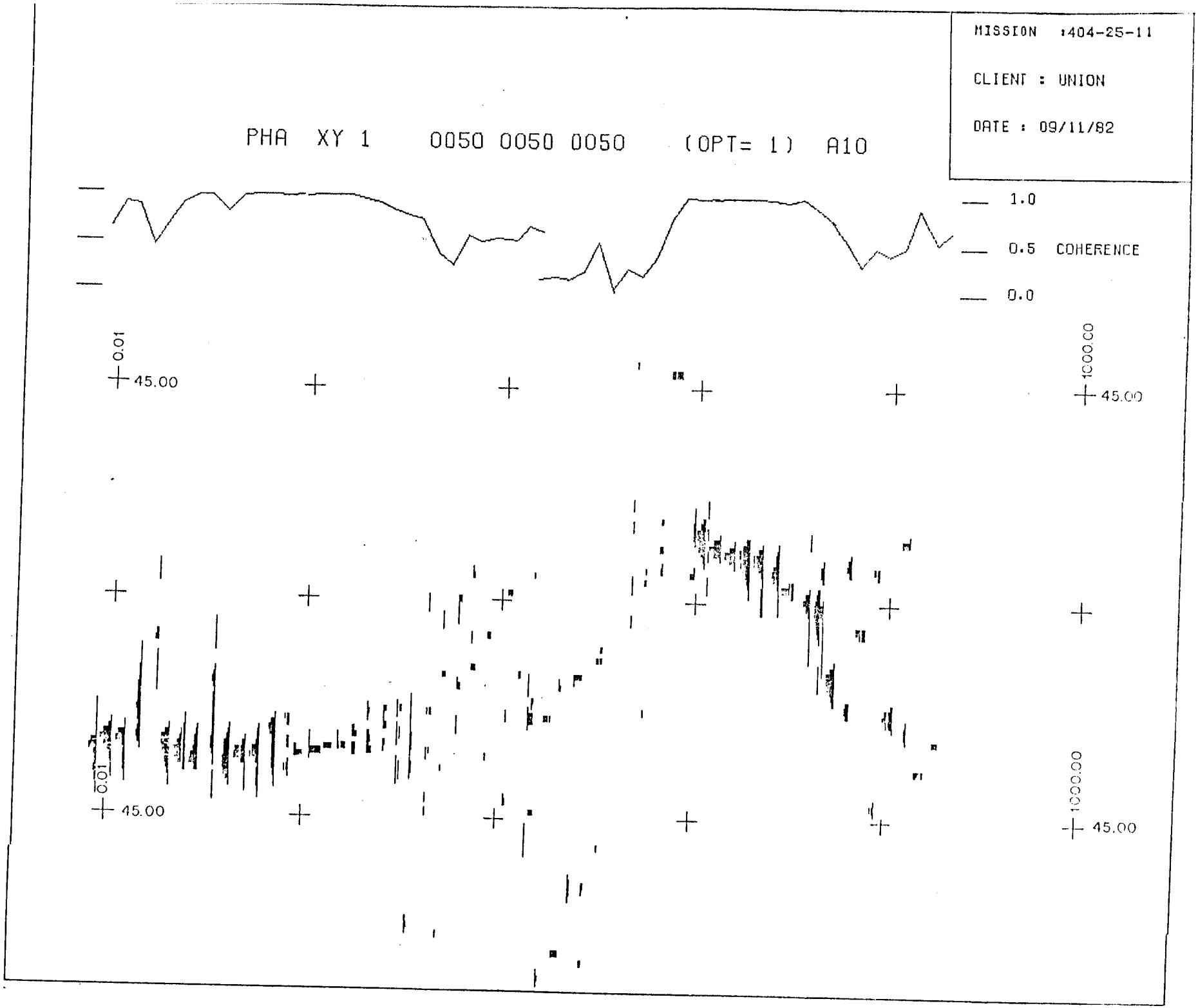

MISSION :404-25-11
CLIENT : UNION
DATE : 05/11/82
RHO INV 1 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

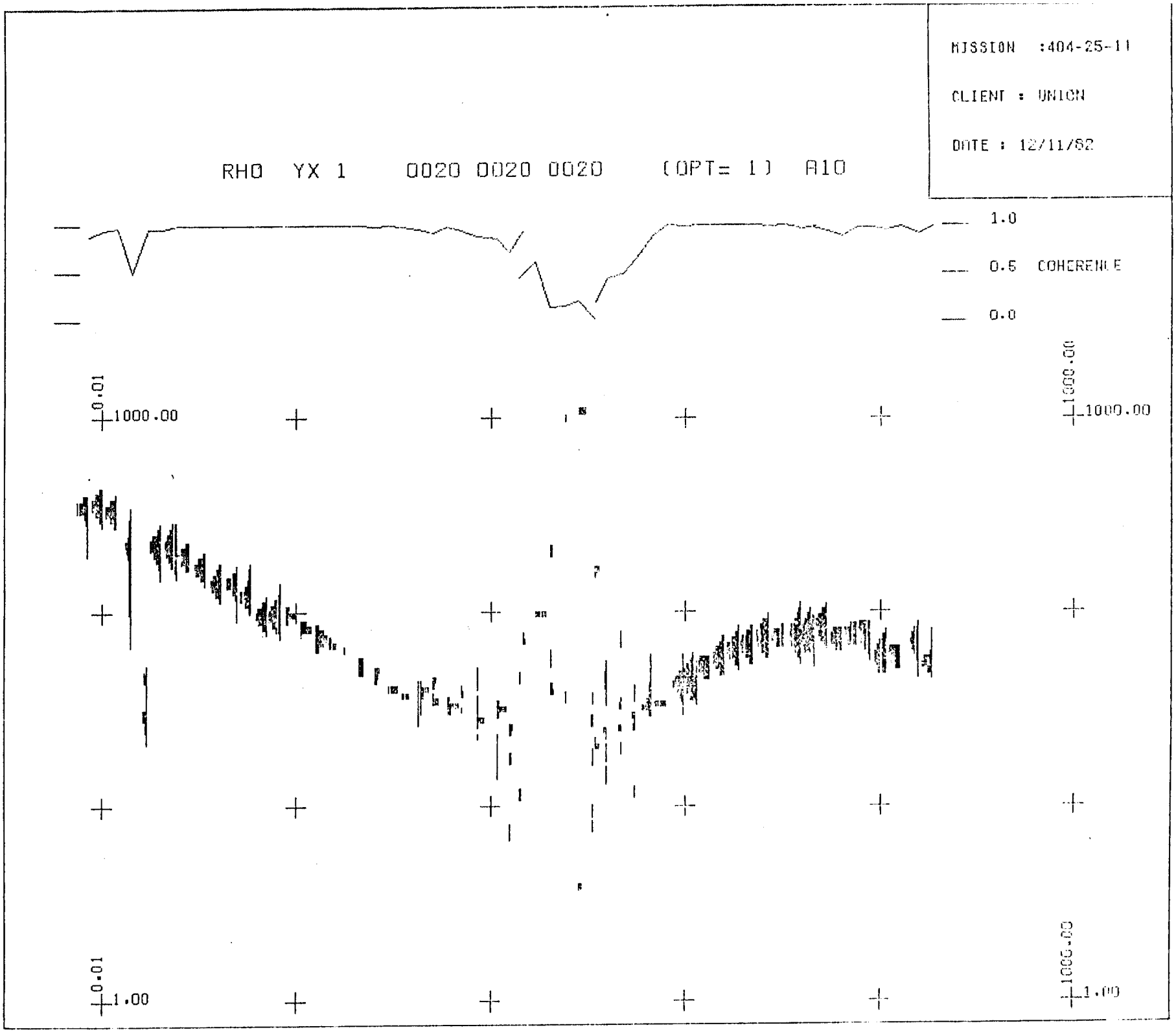

MISSION :404-25-11
CLIENT : UNION
DATE : 06/11/82
RHO INV 2 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1.00

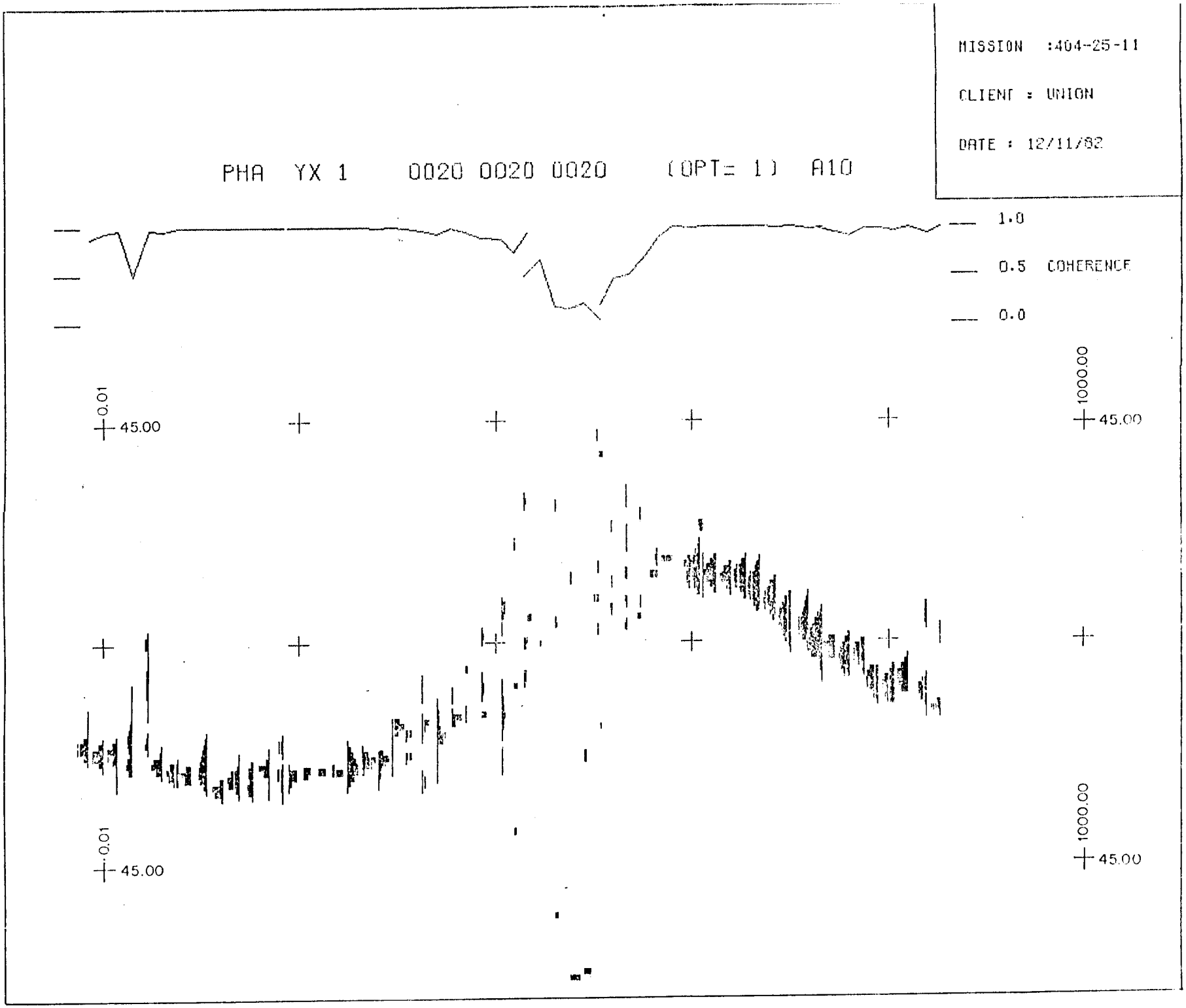

MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
RHO YX 1 0050 0050 0050 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

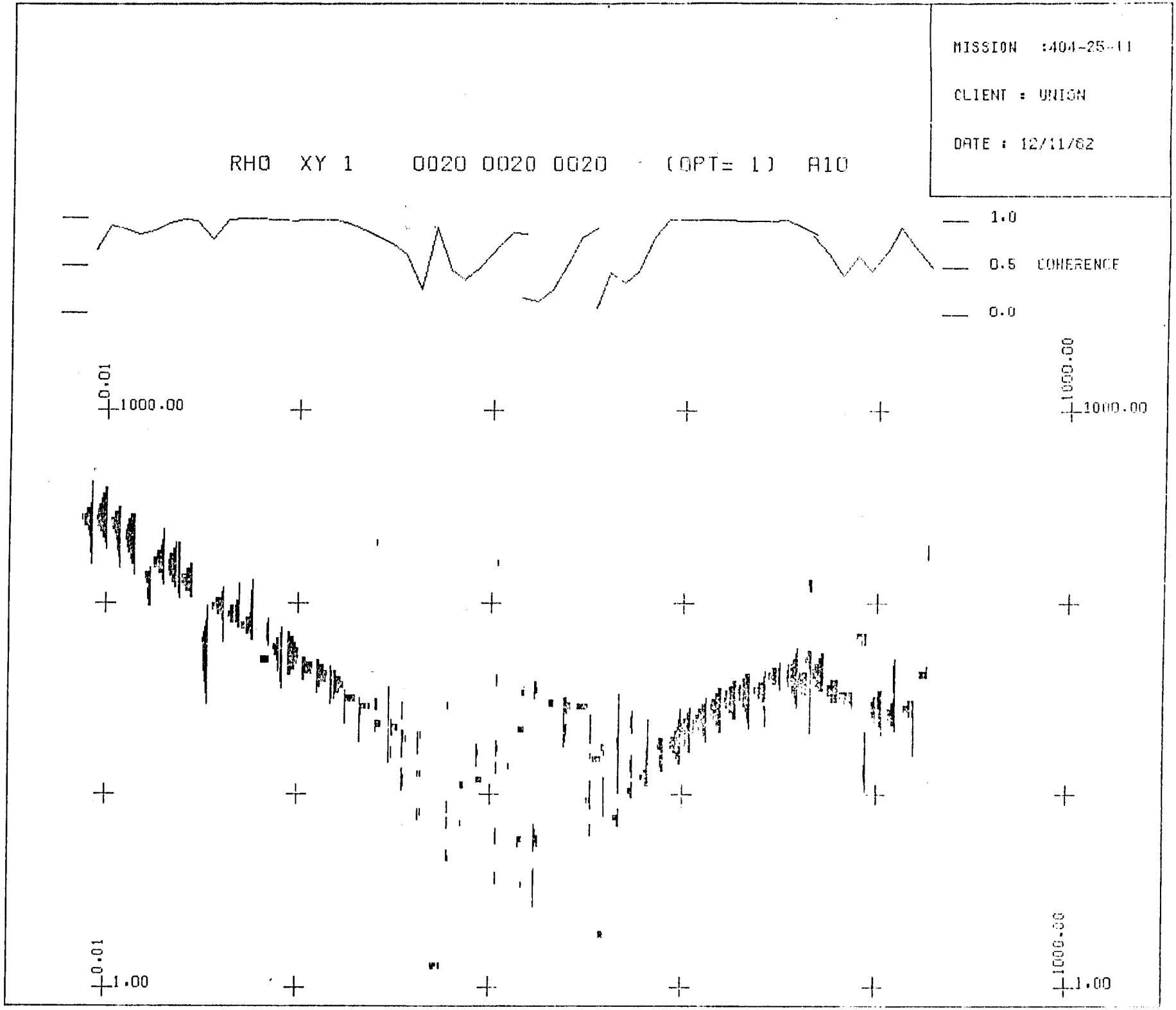

MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
PHA YX 1 0050 0050 0050 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

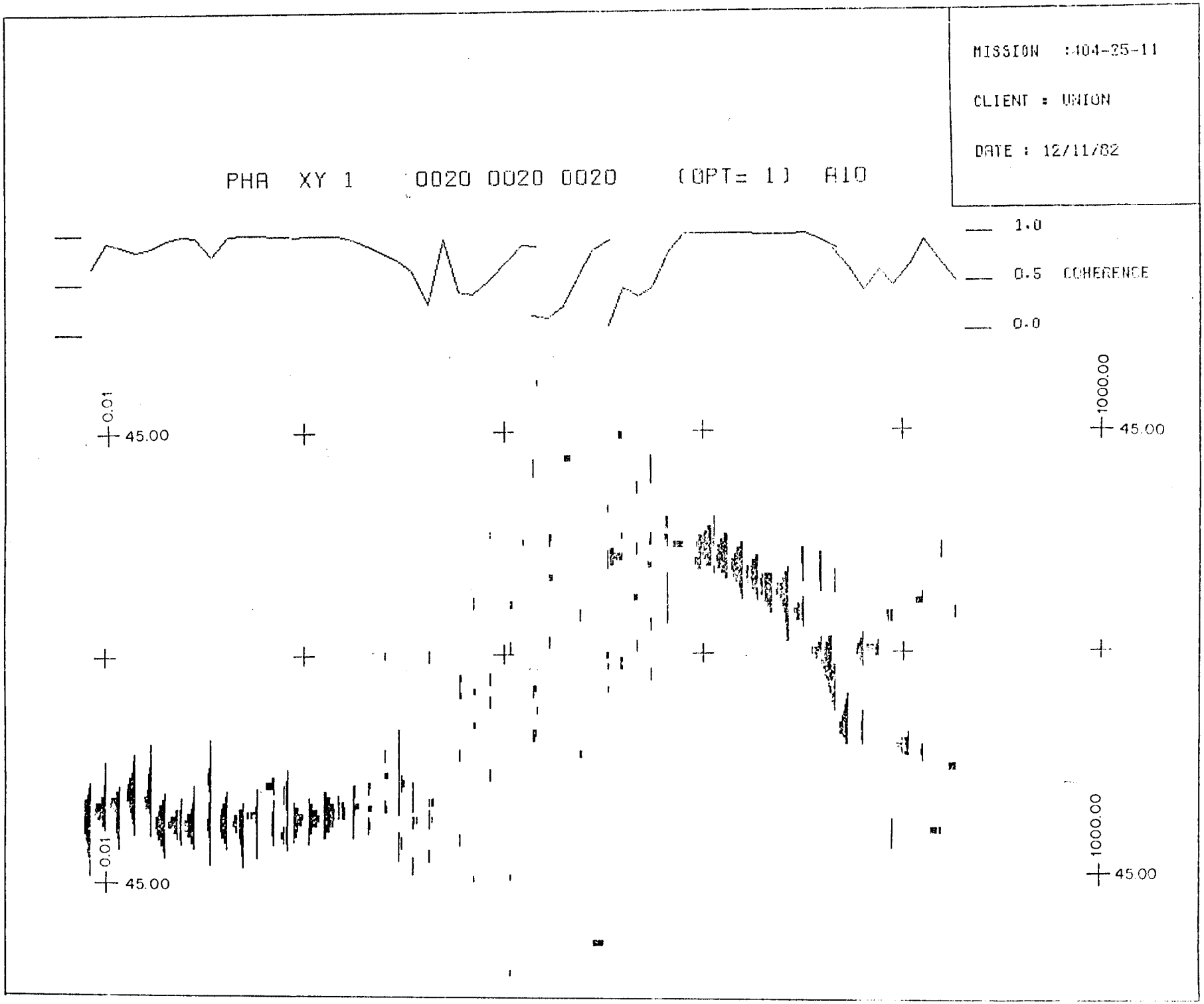

MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
RHO XY 1 0050 0050 0050 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

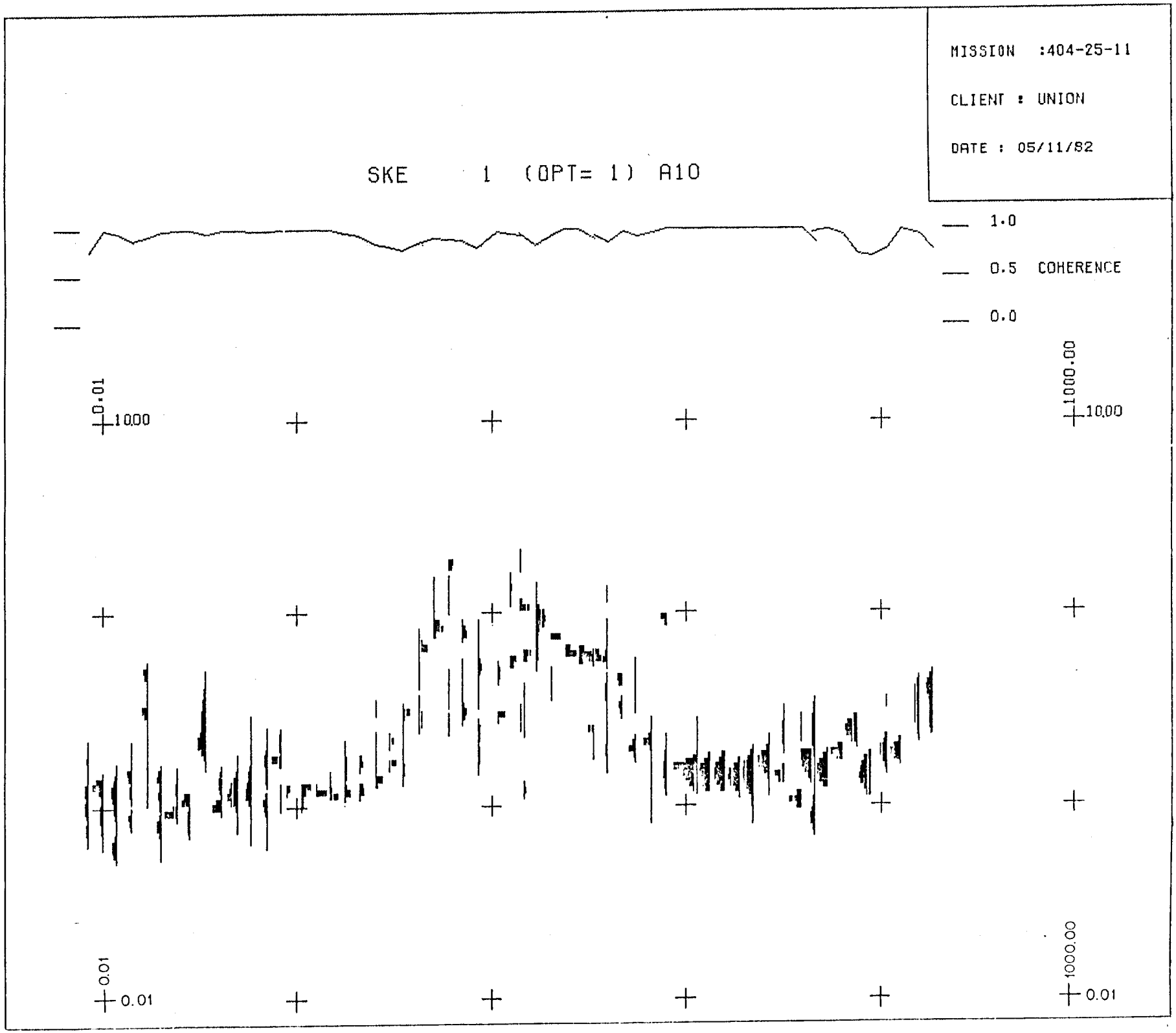

MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
PHA XY 1 0050 0050 0050 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

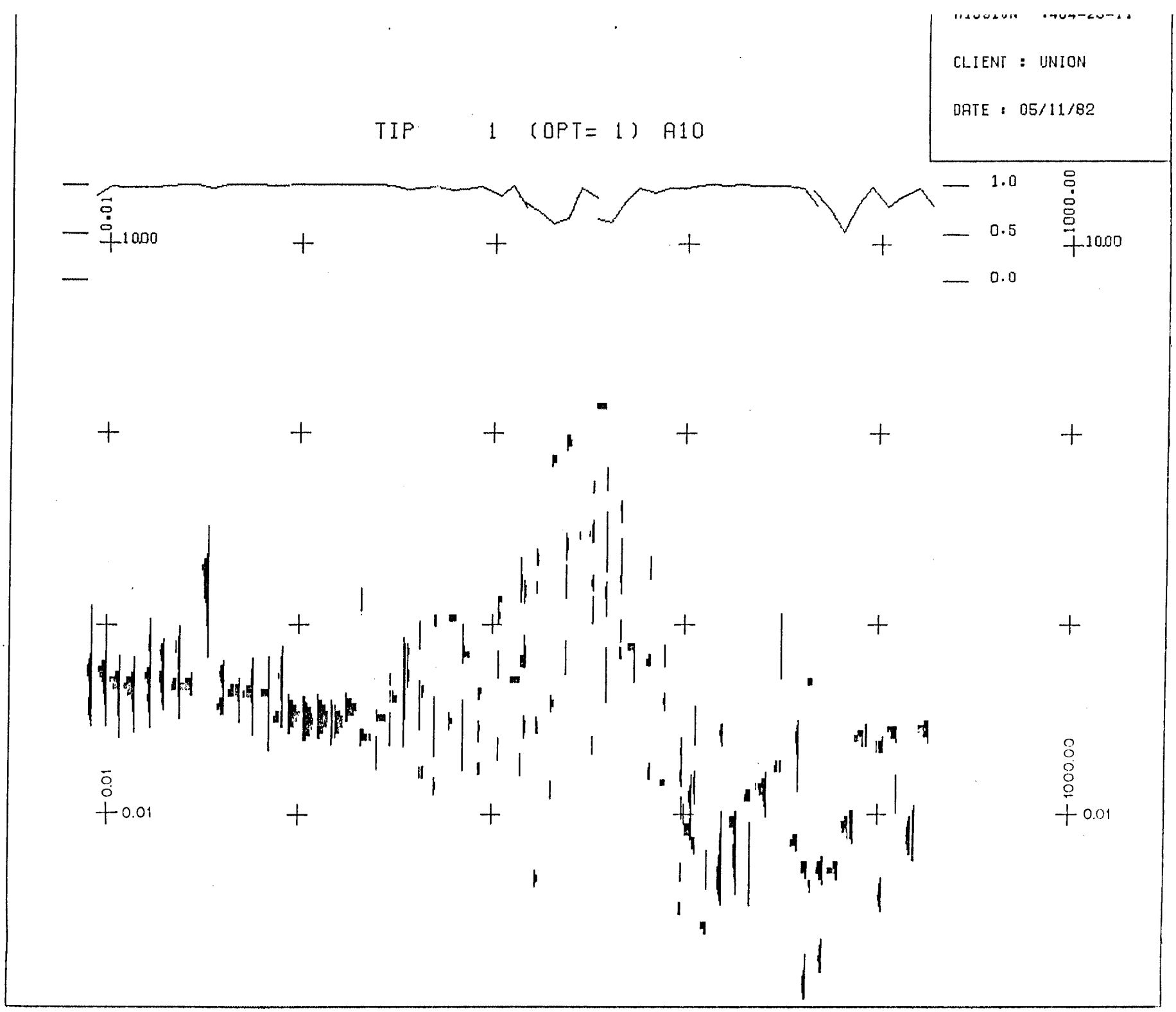

MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
RHO YX 1 0020 0020 0020 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

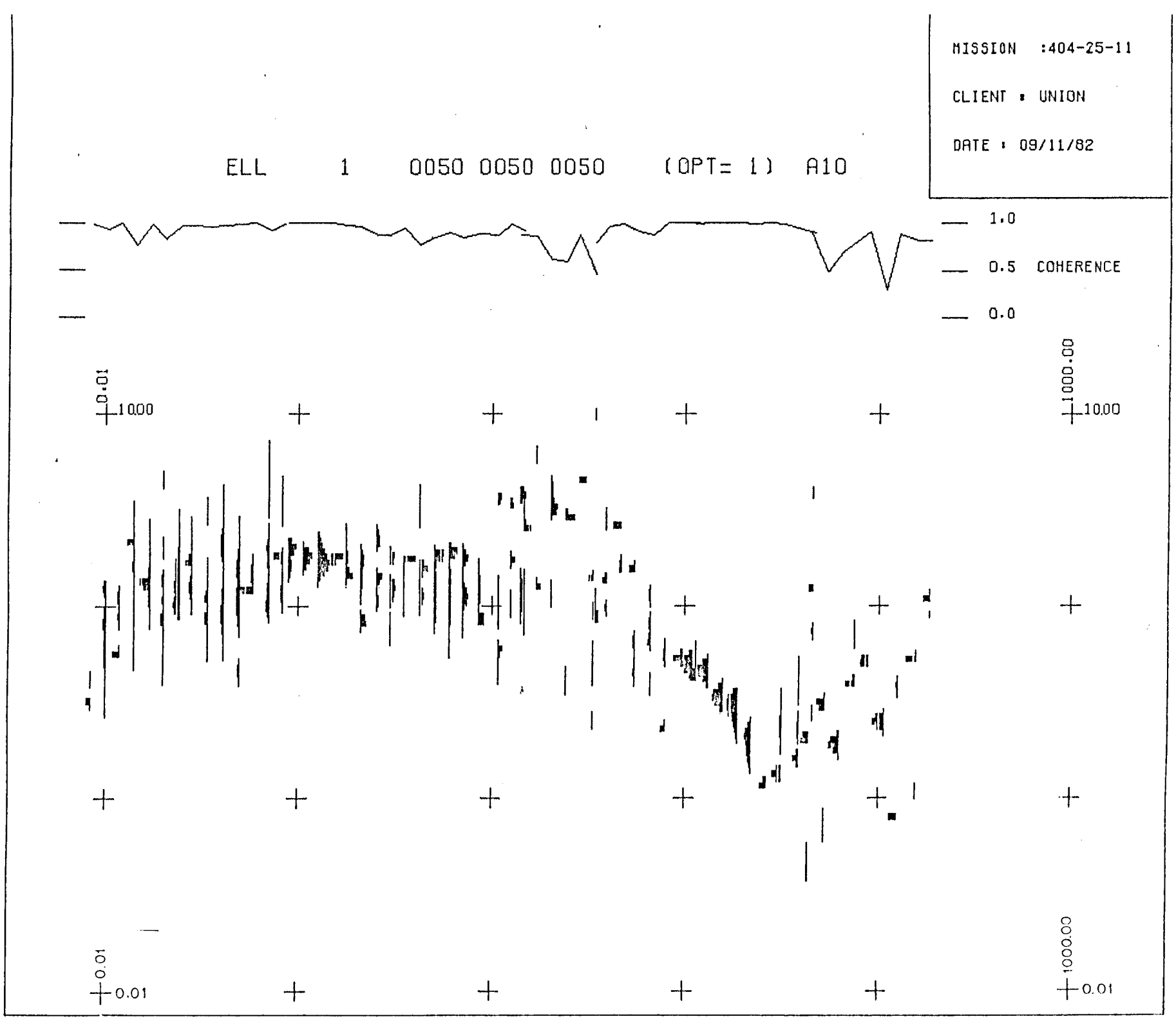

MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
PHA YX 1 0020 0020 0020 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

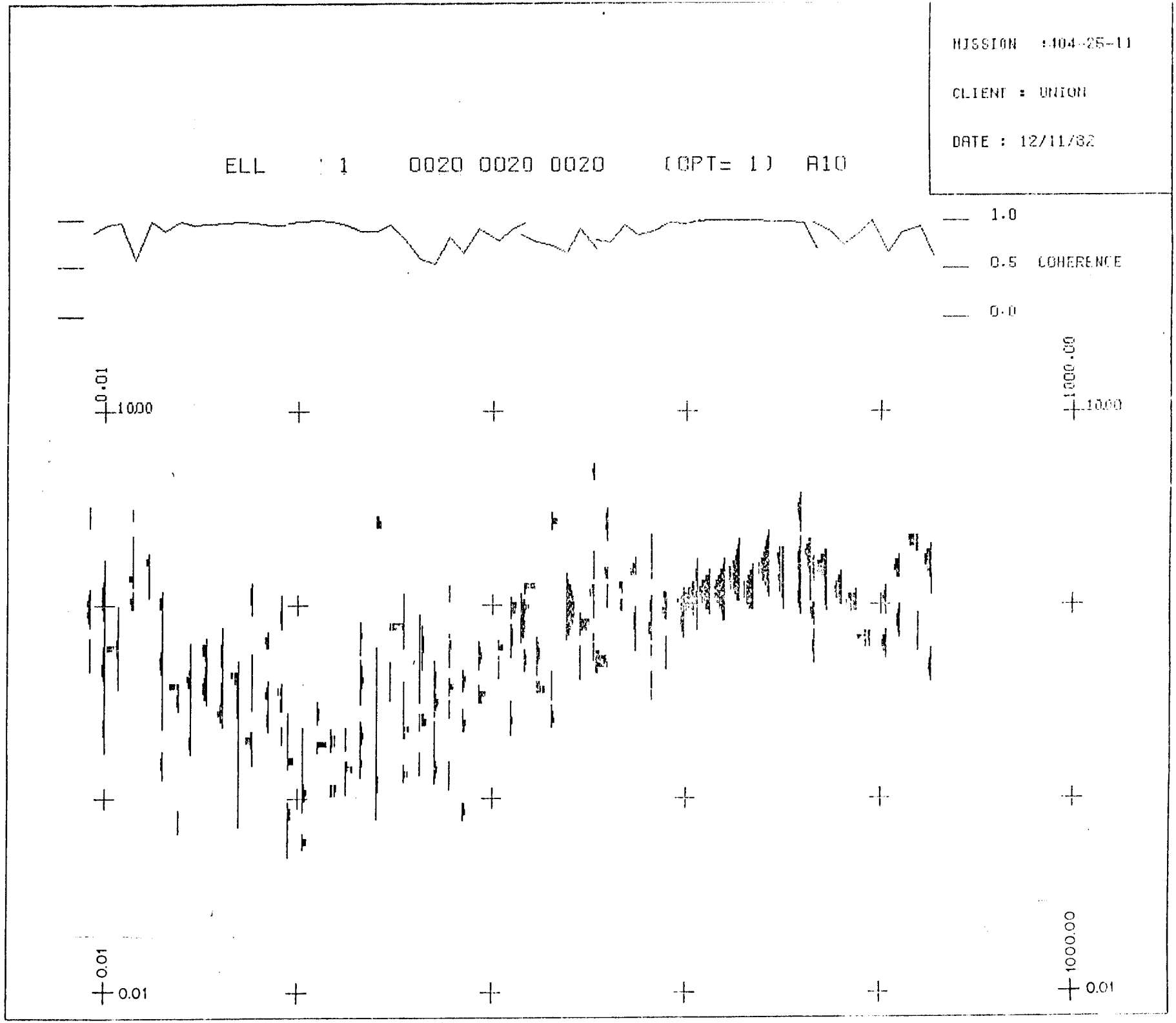

MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
RHO XY 1 0020 0020 0020 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
PHA XY 1 0020 0020 0020 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 05/11/82
SKE 1 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
10.00
0.01
1000.00
0.01


CLIENT : UNION
DATE : 05/11/82
TIP 1 (OPT= 1) A10
0.01
10.00
1.0
0.5
0.0
1000.00
10.00
0.01
0.01
1000.00
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
ELL 1 0050 0050 0050 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000.00
10.00
10.00
0.01
1000.00
0.01
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
ELL 1 0020 0020 0020 (OPT= 1) A10
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
1000
0.01
1000.00
0.01

DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 330gm
SKEW = 0.134
TIPPER = 0.073
COMBINAISON 1

XY

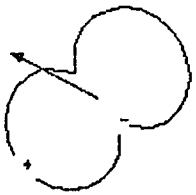
MODULE 3.125 VAL. CENTRALE 18. AZIMUT DU MINIMUM 247°
MAXI 78.1 AMB MOY (MINIMUM) 68°

XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 237°
MAXI 7.83 AMB MOY (MINIMUM) 68°

YZ

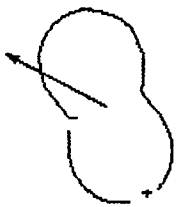
MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 227°
MAXI 0.074 AMB MOY (MAXIMUM) 78°



SKEW = 0.136
TIPPER = 0.068
COMBINAISON 2

XY

MODULE 3.135 VAL. CENTRALE 18. AZIMUT DU MINIMUM 247°
MAXI 78.6 AMB MOY (MINIMUM) 68°

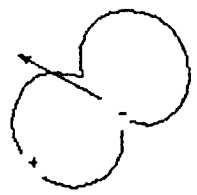


XX

MODULE 1.652 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 237°
MAXI 7.78 AMB MOY (MINIMUM) 68°

YZ

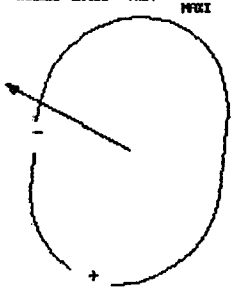
MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 227°
MAXI 0.069 AMB MOY (MAXIMUM) 78°



DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 330m
SKEW = 0.132
TIPPER = 0.164
COMBINAISON 1

SKEW = 0.095
TIPPER = 0.177
COMBINAISON 2

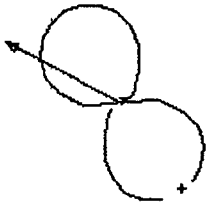
XY



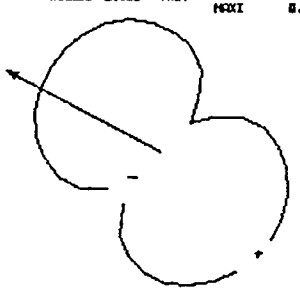
XY

XX

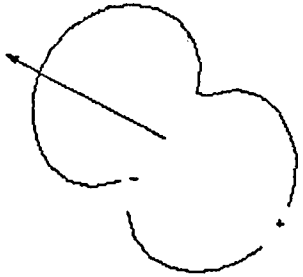
XX



YZ



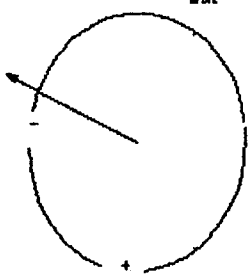
YZ



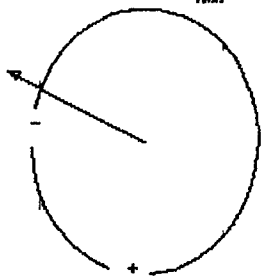
DOMAINE MF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 330°
SKEW = 0.088
TIPPER = 0.193
COMBINAISON 1

SKEW = 0.083
TIPPER = 0.196
COMBINAISON 2

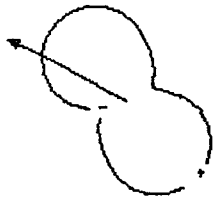
XY



XY

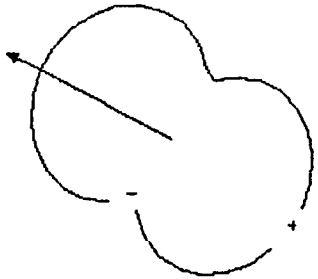


XX

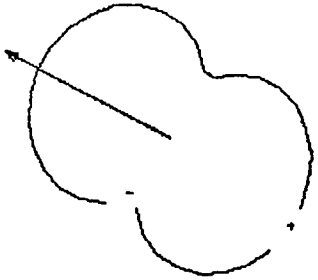


XX

YZ



YZ



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 11

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/14 | 5 | | 4 | | 6 | |
| 10/15 | 8<br>11 | A<br>B | 7<br>10 | A<br>B | 9 | A-B |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 25 | 22.5 = 22.5°E |
| | Ey | 325 | 292.5 = 67.5°W |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 42°5W | 155 | 227.5 = 47.5E | YX | XY |
| STRIKE from Hz | 40°W | | | | |

## COMMENTS

### FIELD

10/14: high resistance on the electrodes

10/15: lower resistance
ok. fair signal

### PROCESSING

Fair

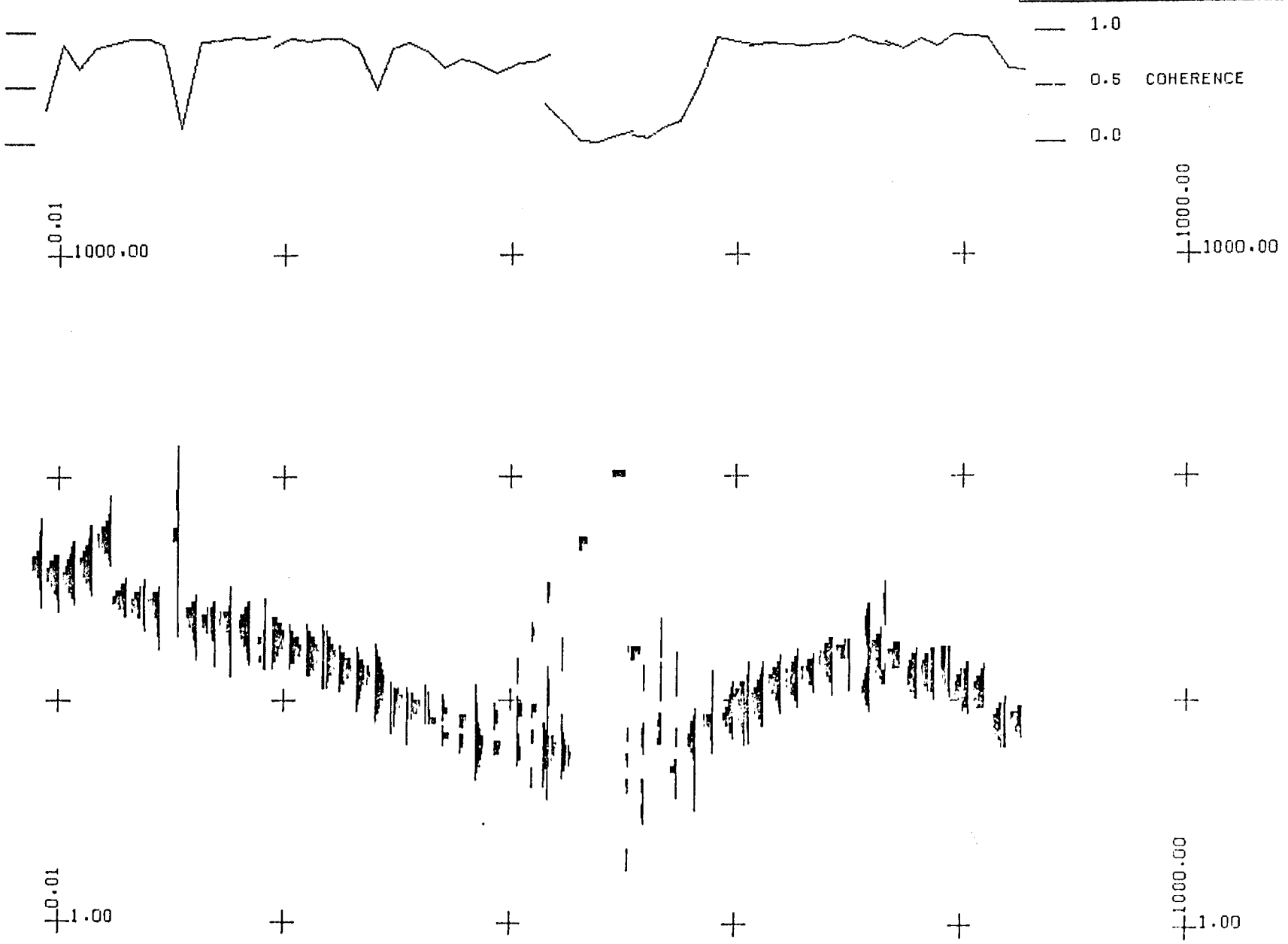
HF: $\rho E > \rho H$
LF: $\rho E > \rho H$ } superficial inhomogeneity ?

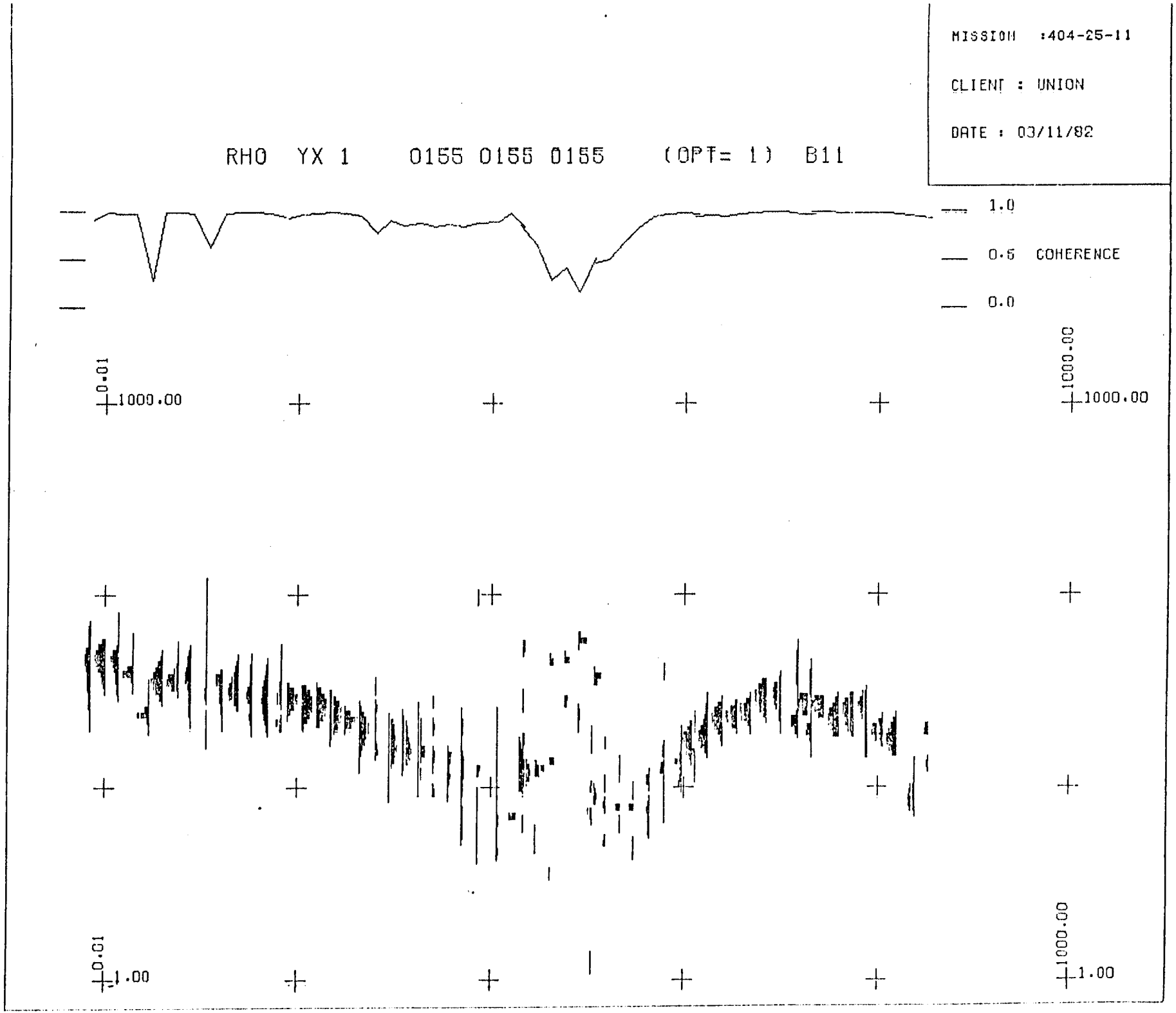
MISSION :404-25-11

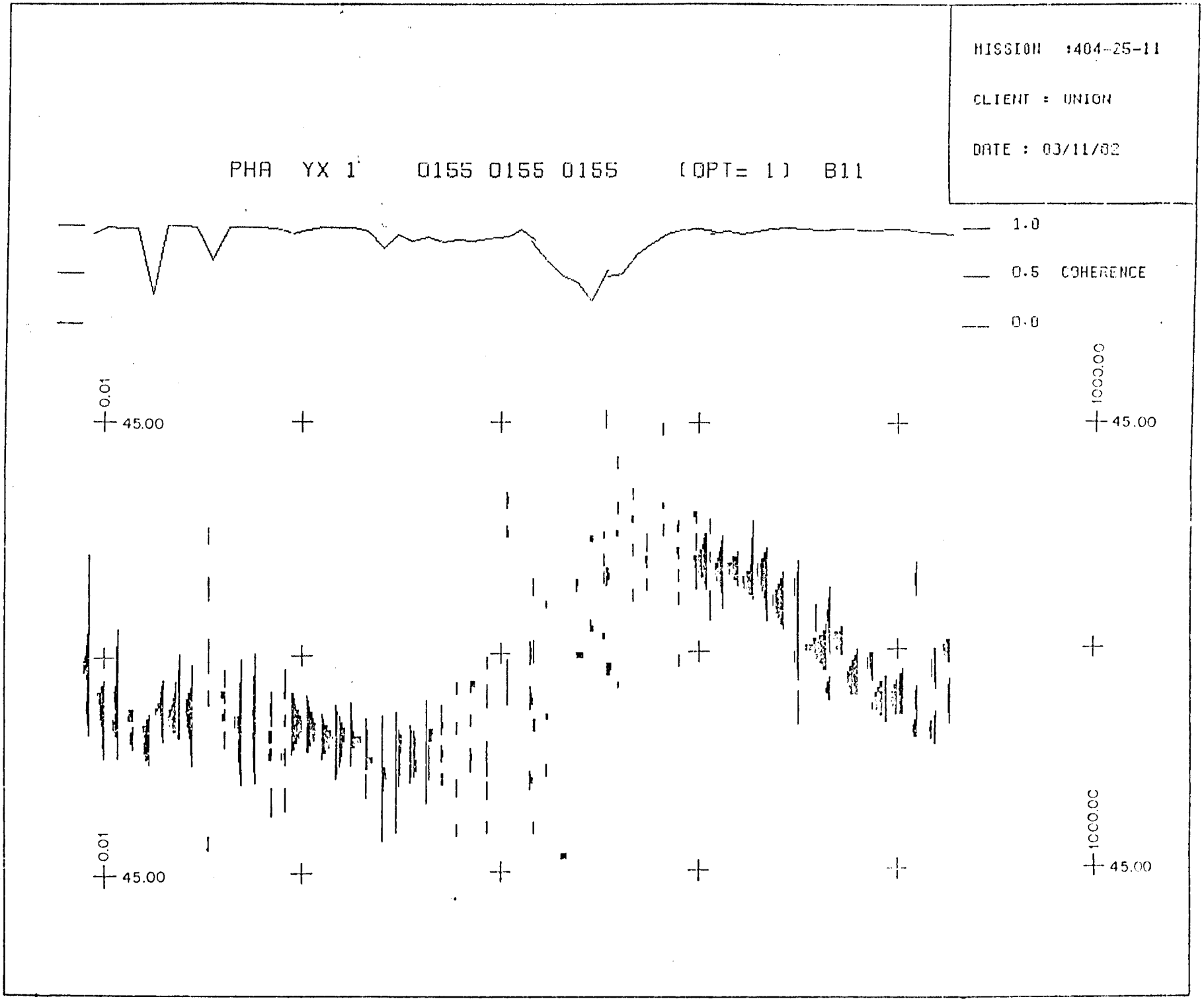
CLIENT : UNION

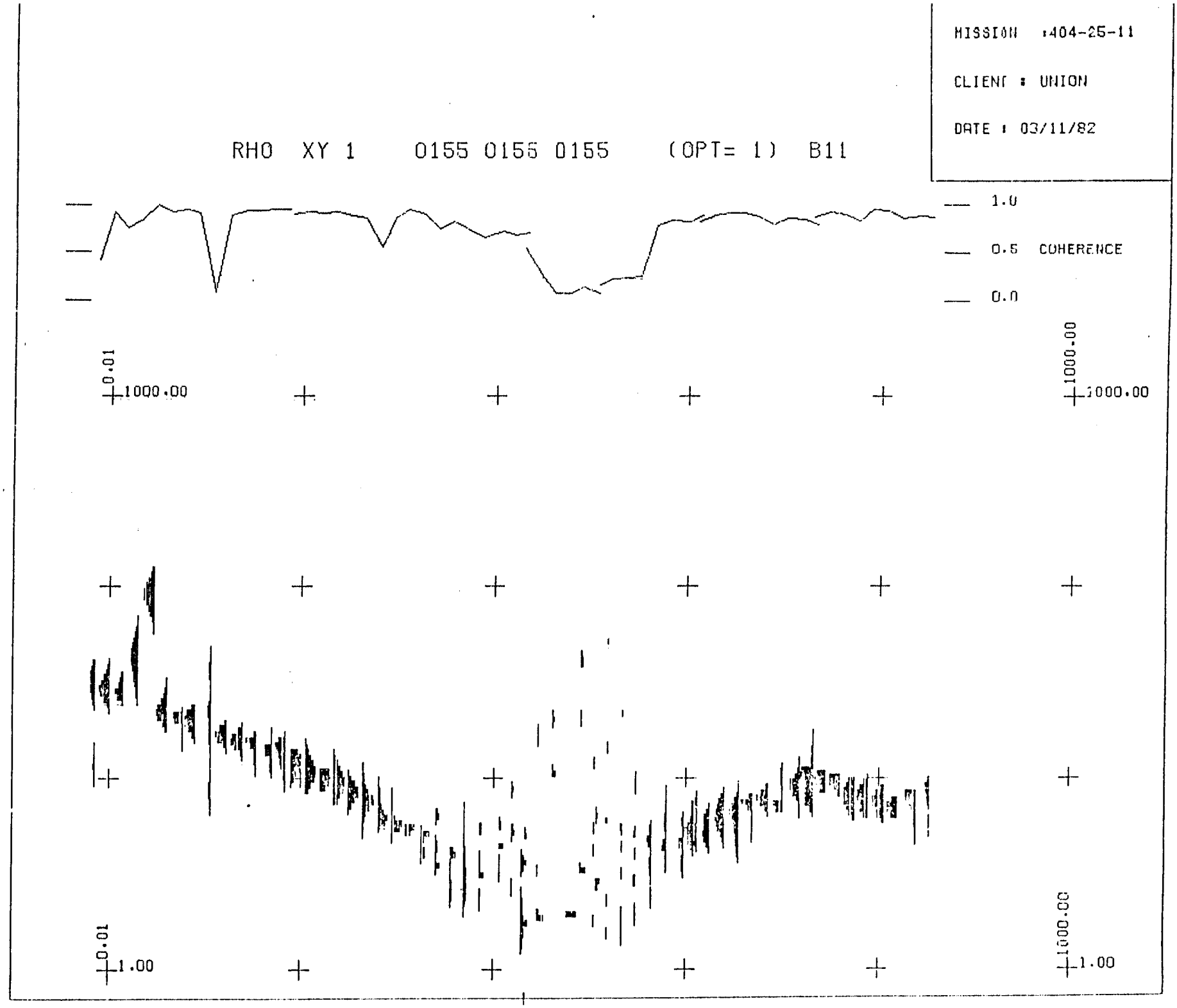
DATE : 28/10/82

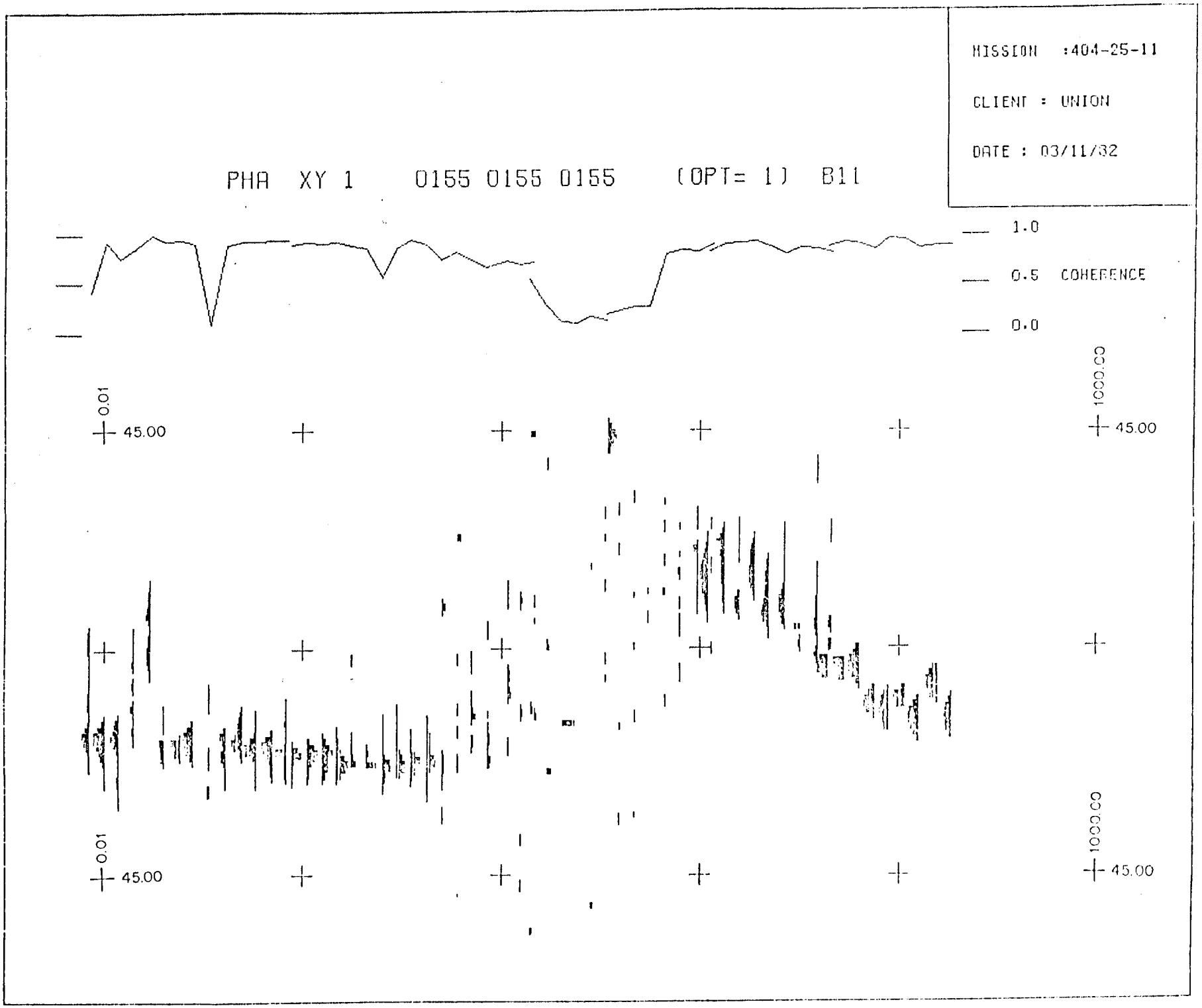
RHO INV 1 (OPT= 1) B11

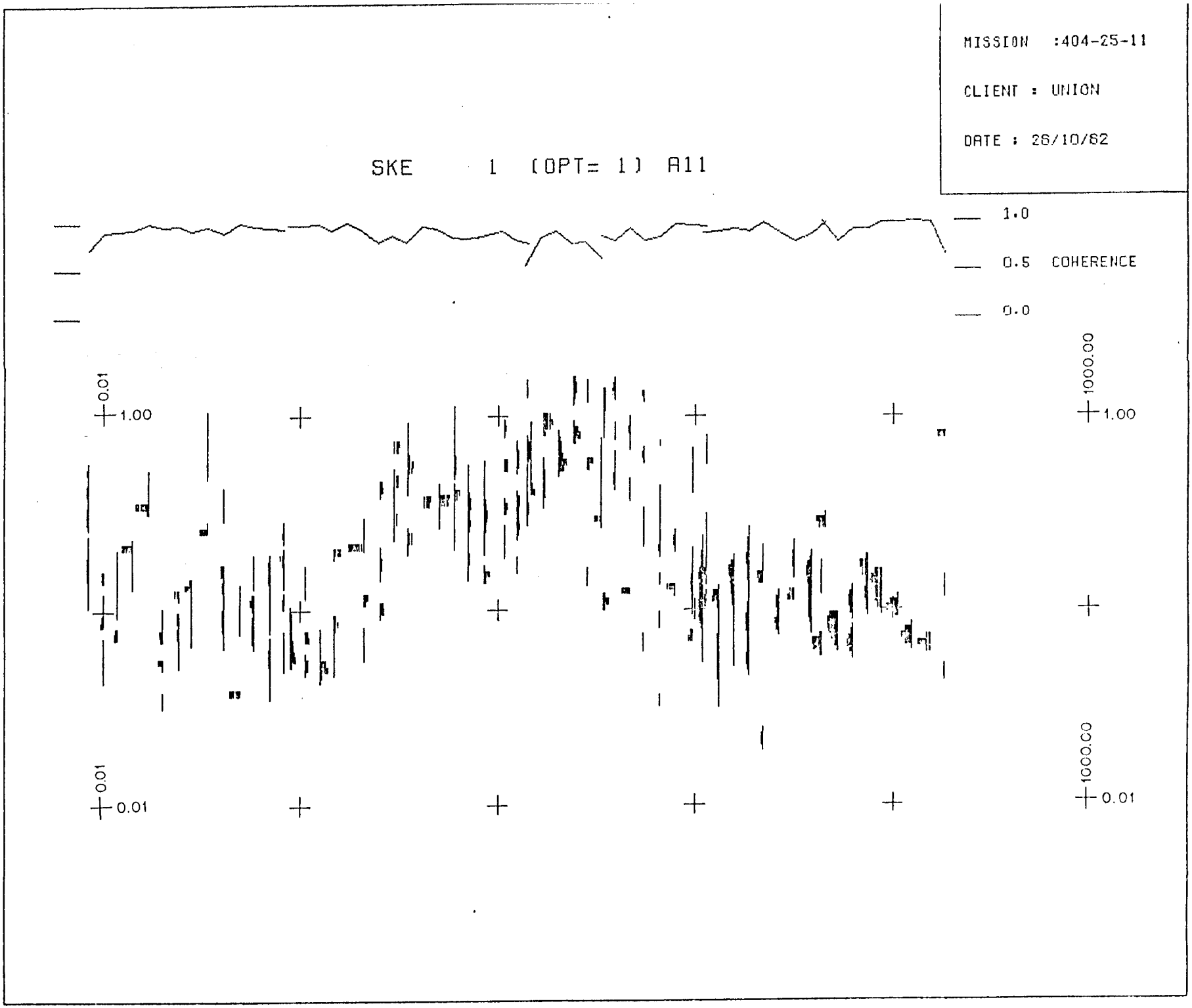


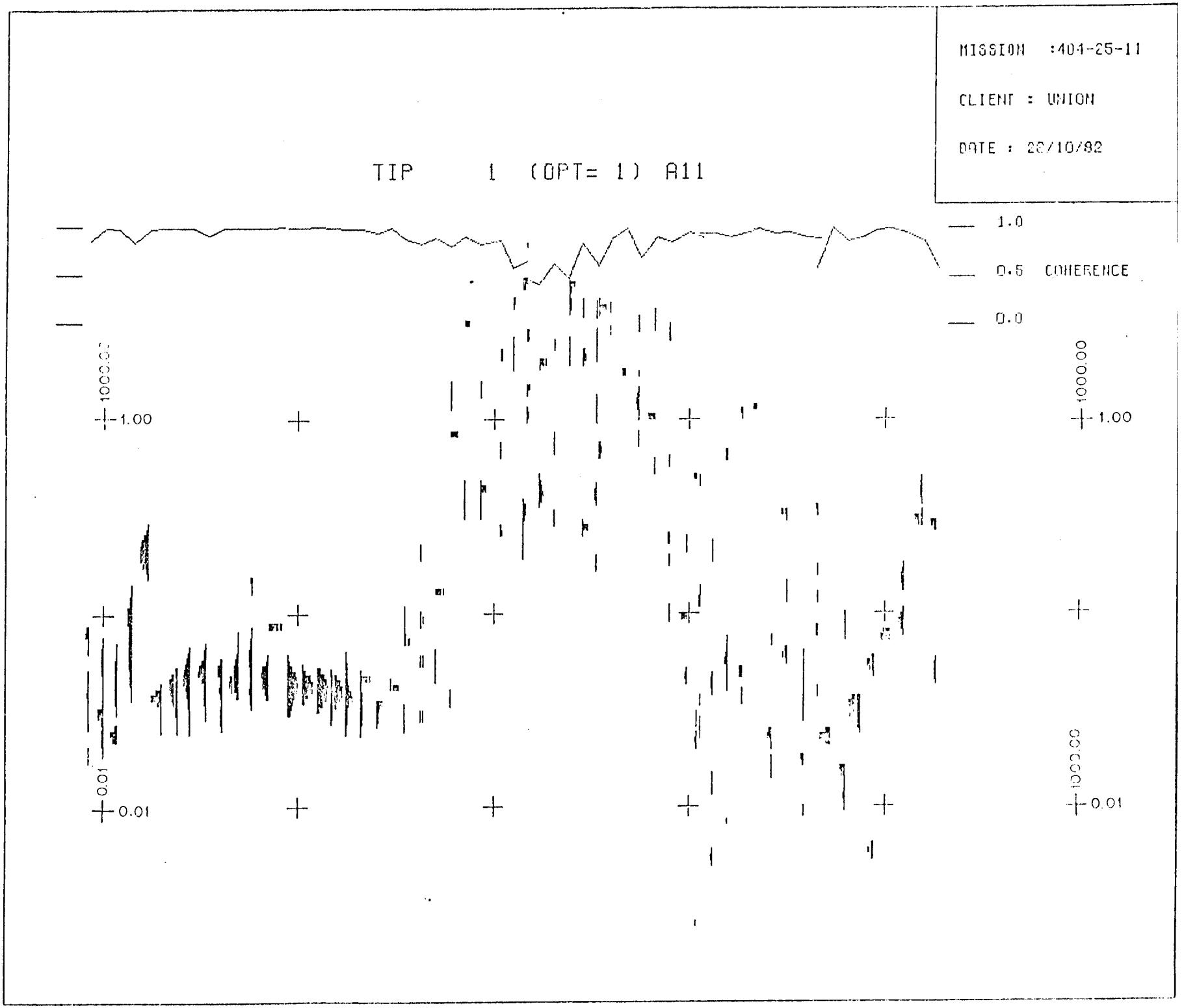

MISSION :404-25-11
CLIENT : UNION
DATE : 03/11/82
RHO YX 1 0155 0155 0155 (OPT= 1) B11
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 03/11/82
PHA YX 1 0155 0155 0155 (OPT= 1) B11
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 03/11/82
RHO XY 1 0155 0155 0155 (OPT= 1) B11
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

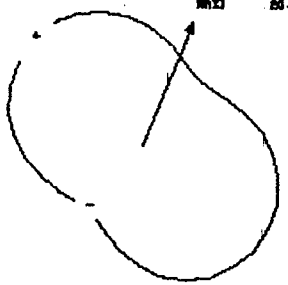

MISSION :404-25-11
CLIENT : UNION
DATE : 03/11/32
PHA XY 1 0155 0155 0155 (OPT= 1) B11
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 26/10/82
SKE 1 (OPT= 1) A11
1.0
0.5 COHERENCE
0.0
0.01
1.00
0.01
0.01
1000.00
1.00
1000.00
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 22/10/82
TIP 1 (OPT= 1) A11
1.0
0.5 COHERENCE
0.0
1000.00
1.00
0.01
1000.00
1.00
0.01

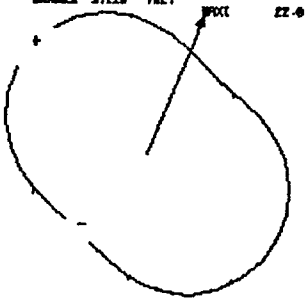
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 25°
SKEW = 0.043
TIPPER = 0.107
COMBINAISON 1



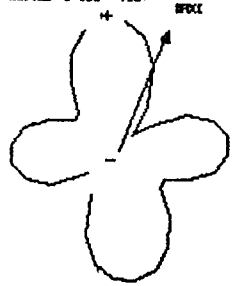


SKEW = 0.048
TIPPER = 0.108
COMBINAISON 2





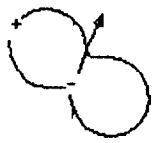




DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT:EX 25°
SKEW = 0.087
TIPPER = 0.190
COMBINAISON 1

XY

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 213°
MAXI 47.7 ANG ROT (MINIMUM) 170°

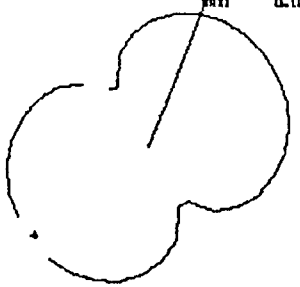


XX

MODULE 0.781 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 213°
MAXI 3.749 ANG ROT (MINIMUM) 170°

YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 233°
MAXI 0.101 ANG ROT (MAXIMUM) 160°



SKEW = 0.071
TIPPER = 0.193
COMBINAISON 2

XY

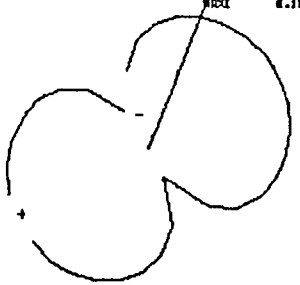
MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 223°
MAXI 82.7 ANG ROT (MINIMUM) 160°

XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 213°
MAXI 4.79 ANG ROT (MINIMUM) 170°

YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 243°
MAXI 0.193 ANG ROT (MAXIMUM) 140°



DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 25°
SKEW = 0.055
TIPPER = 0.213
COMBINAISON 1

MISSION : 404-25-11
CLIENT : UNION
DATE : 05/11/82

SKEW = 0.057
TIPPER = 0.212
COMBINAISON 2

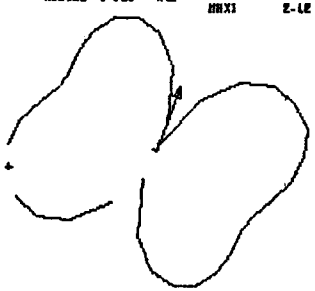
XY

MODULE 3.135 VAL. CENTRALE 10. AZIMUT DU MINIMUM 215°
MAXI 37.2 AND ROT (MINIMUM) 170°

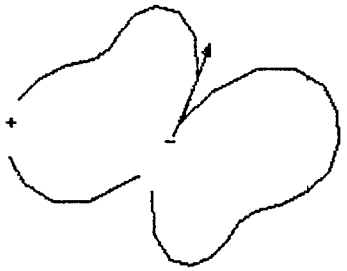
MODULE 3.135 VAL. CENTRALE 10. AZIMUT DU MINIMUM 215°
MAXI 42.9 AND ROT (MINIMUM) 170°

XX

MODULE 3.135 VAL. CENTRALE 8-1 AZIMUT DU MINIMUM 217°
MAXI 2.12 AND ROT (MINIMUM) 170°

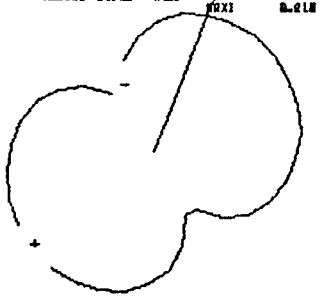


MODULE 3.135 VAL. CENTRALE 8-1 AZIMUT DU MINIMUM 217°
MAXI 2.82 AND ROT (MINIMUM) 170°

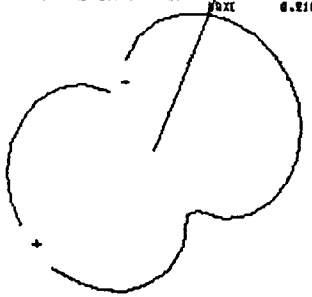


YZ

MODULE 3.135 VAL. CENTRALE 8-01 AZIMUT DU MINIMUM 233°
MAXI 8.218 AND ROT (MINIMUM) 160°



MODULE 3.135 VAL. CENTRALE 8-01 AZIMUT DU MINIMUM 233°
MAXI 8.218 AND ROT (MINIMUM) 160°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 12

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/16 | 18 | A | 17 | A | 19 | A-B |
| | 21 | B | 20 | B | | |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 160 | 144 = 144°E |
| | Ey | 60 | 54 = 54°E |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 26°W | 80 | 64 = 64E | YX | XY |
| STRIKE from Hz | 56°W | | | | |

## COMMENTS

### FIELD

Fair signal
very light thunderstorm

### PROCESSING

Fair, except between 1 and 10 sec.

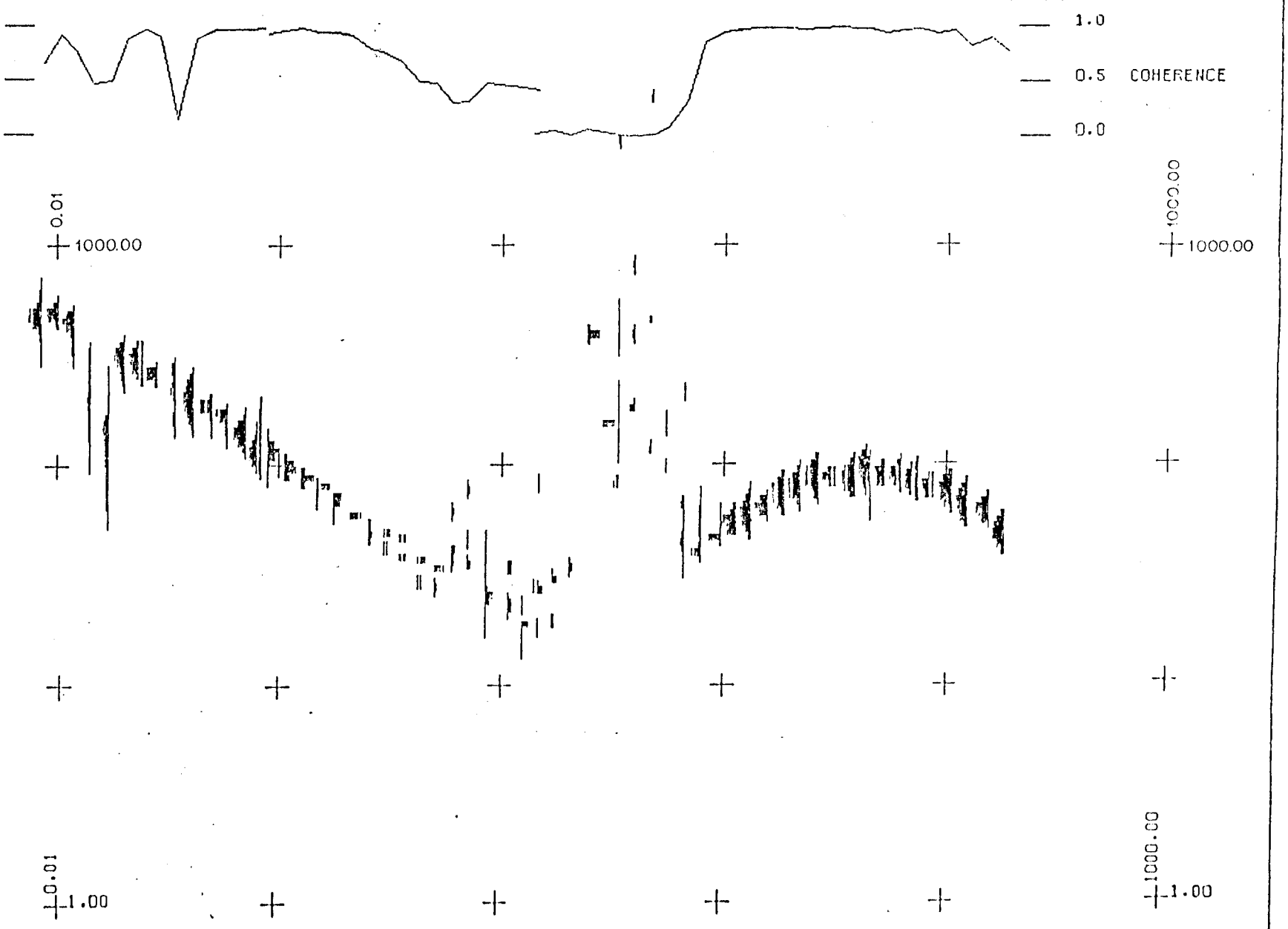
HF: $\rho E\# > \rho H$
LF: $\rho E\# > \rho H$

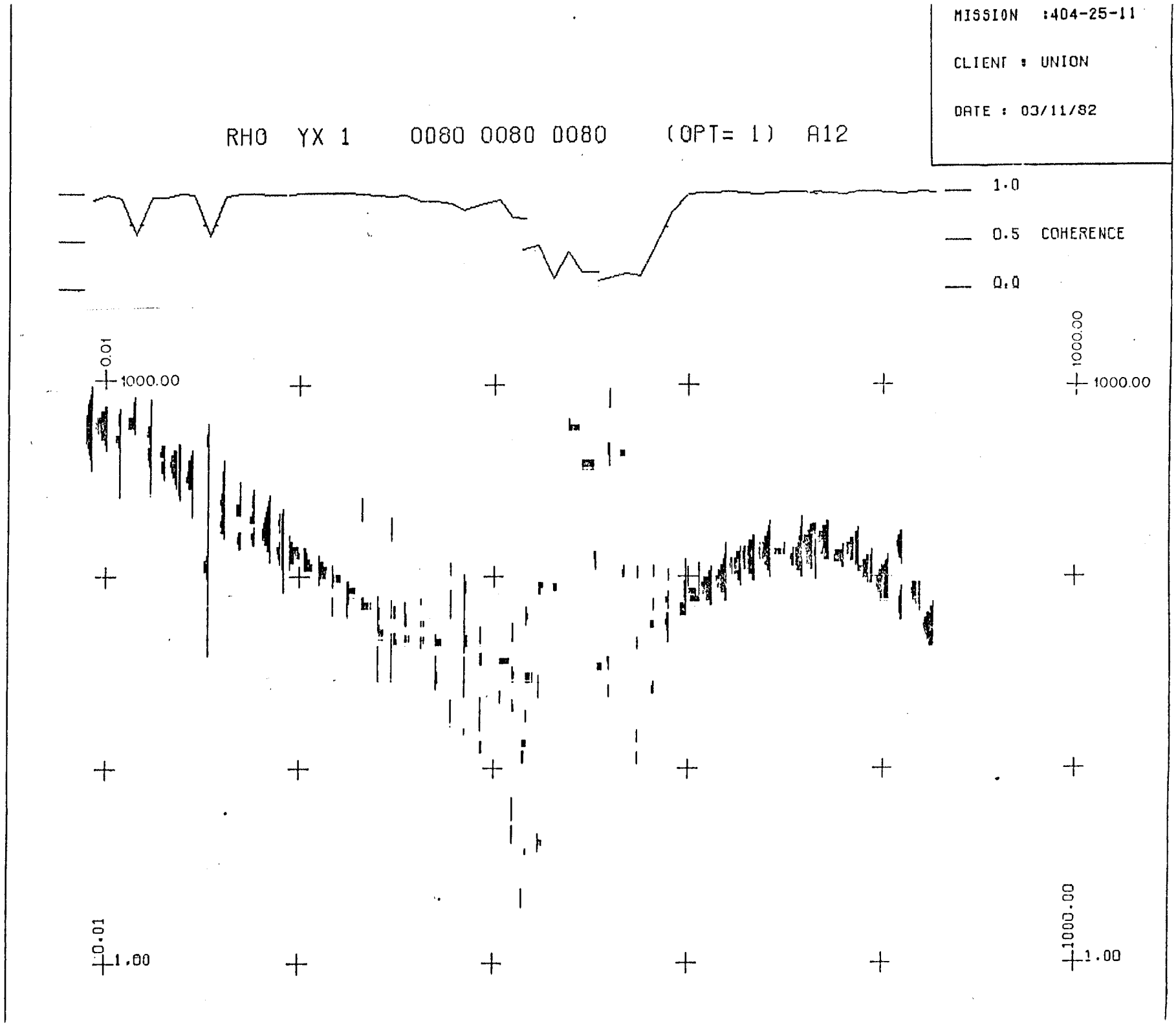
MISSION :404-25-11

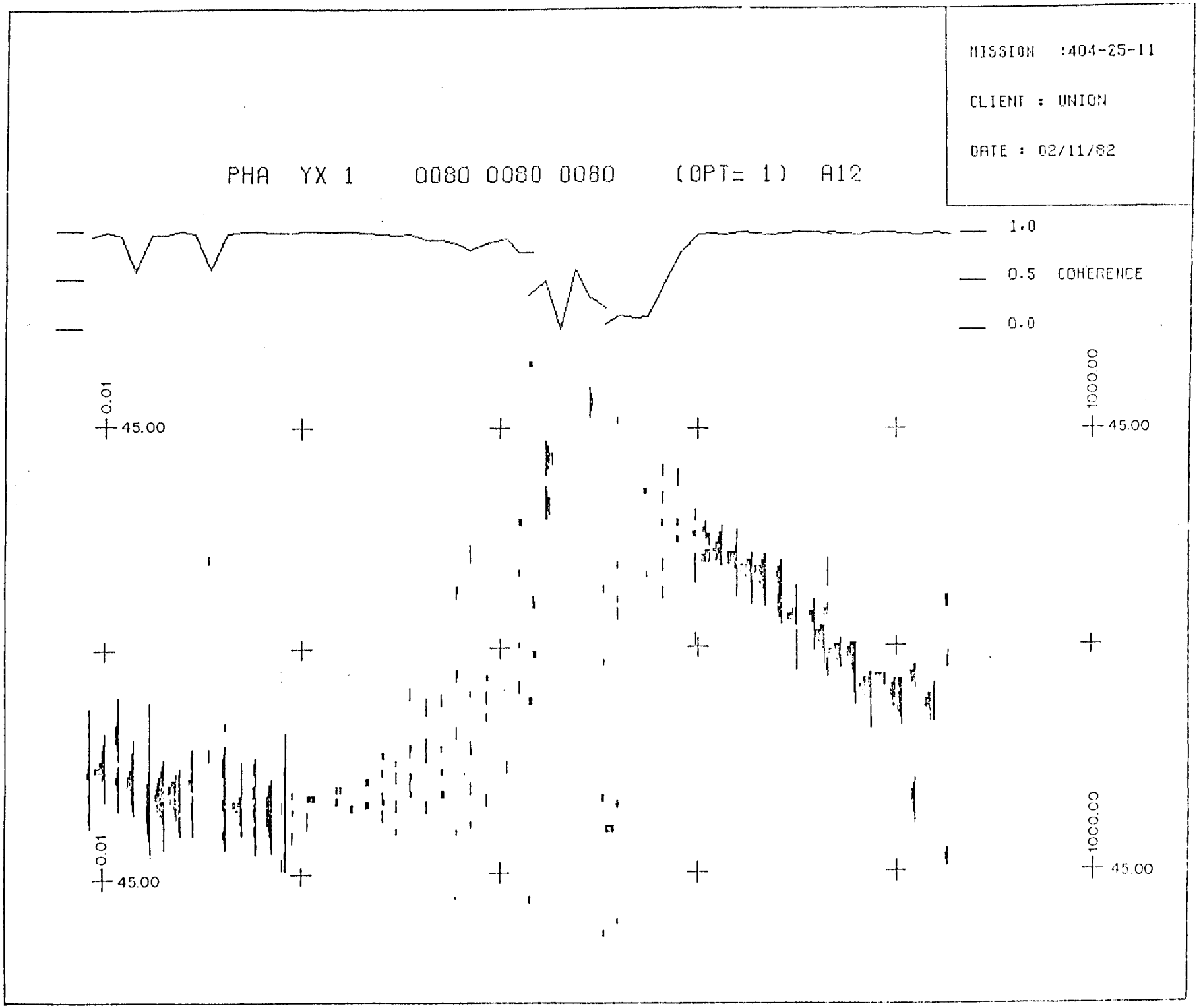
CLIENT : UNION

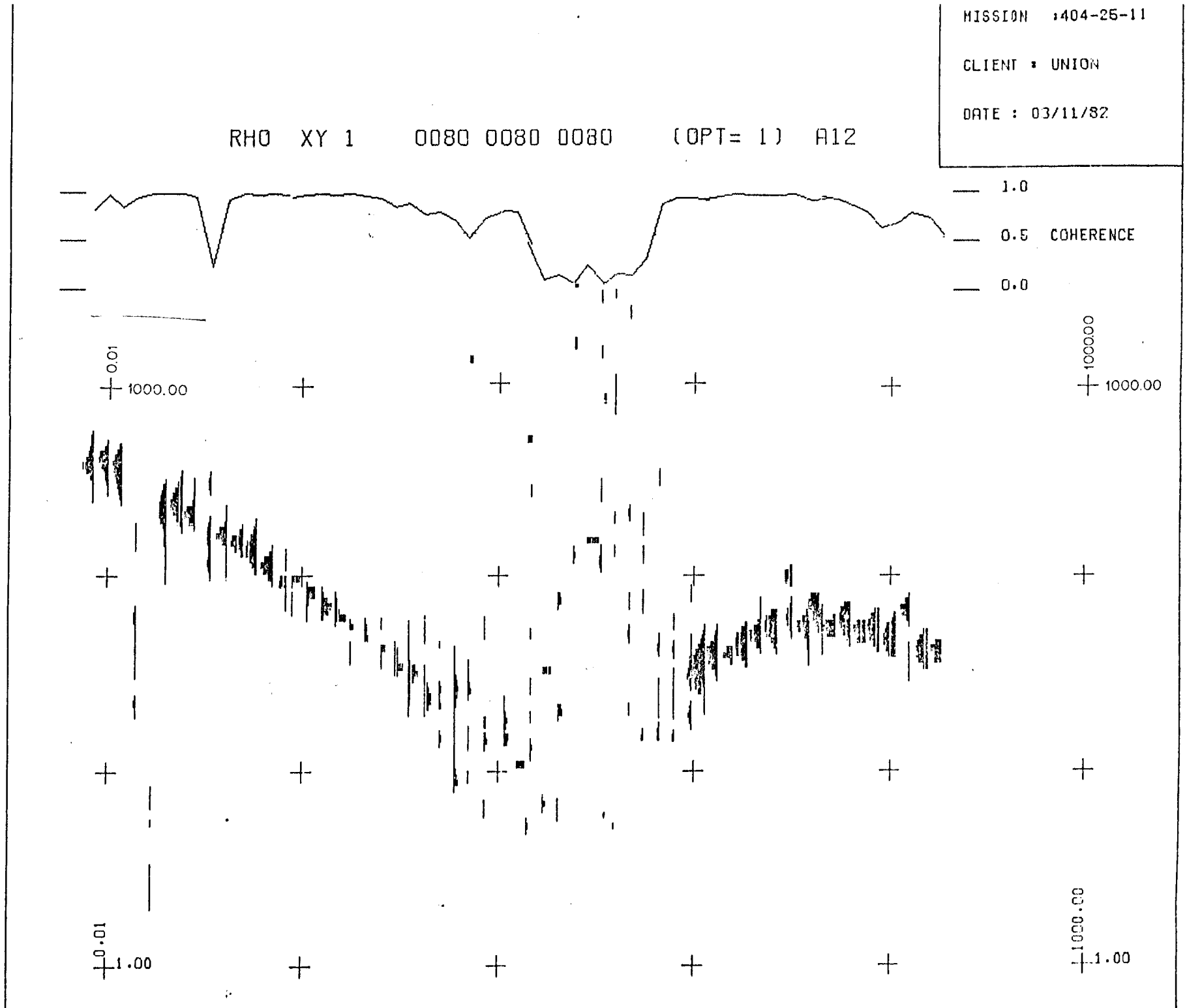
DATE : 28/10/82

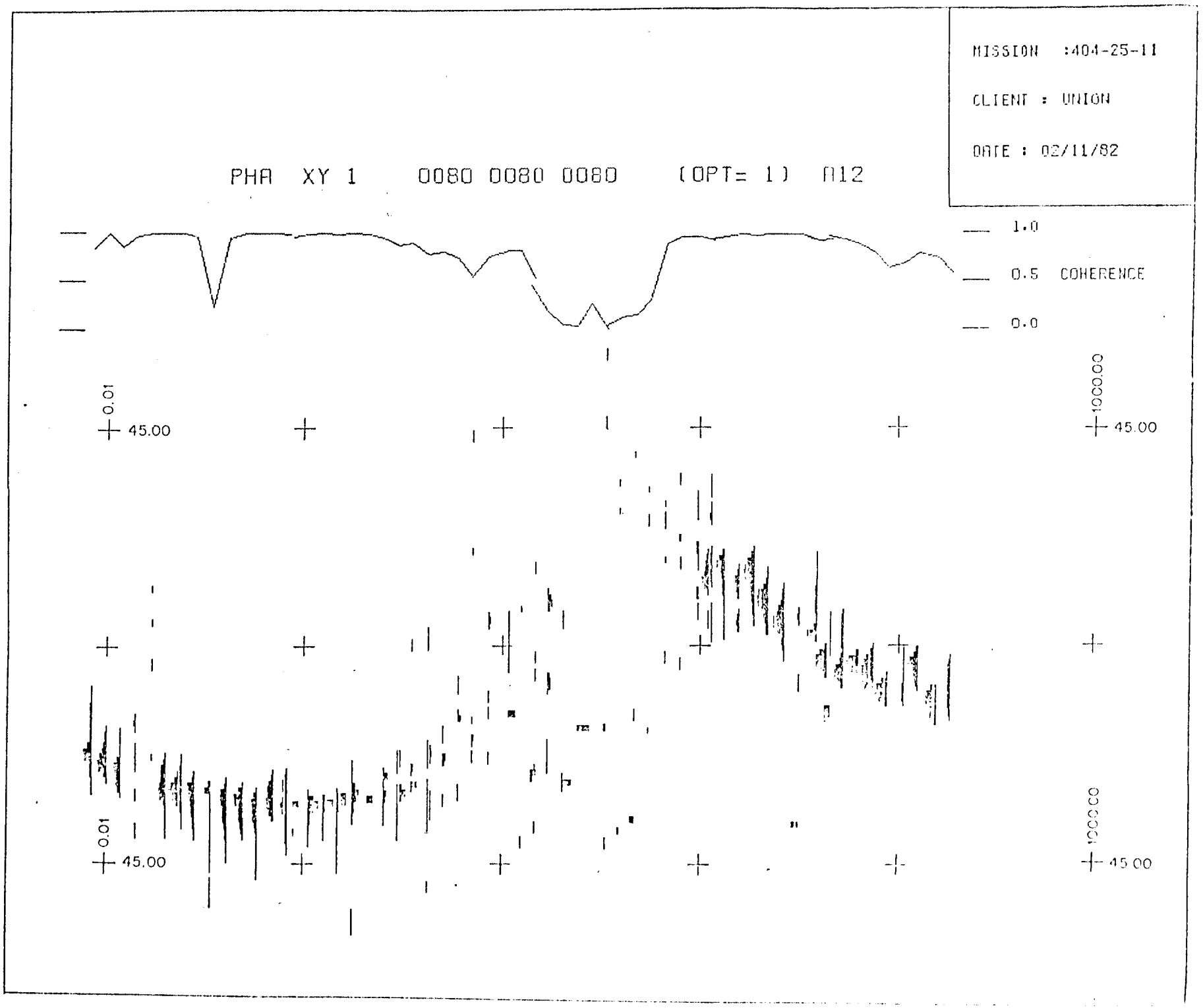
RHO INV I (OPT= 1) A12

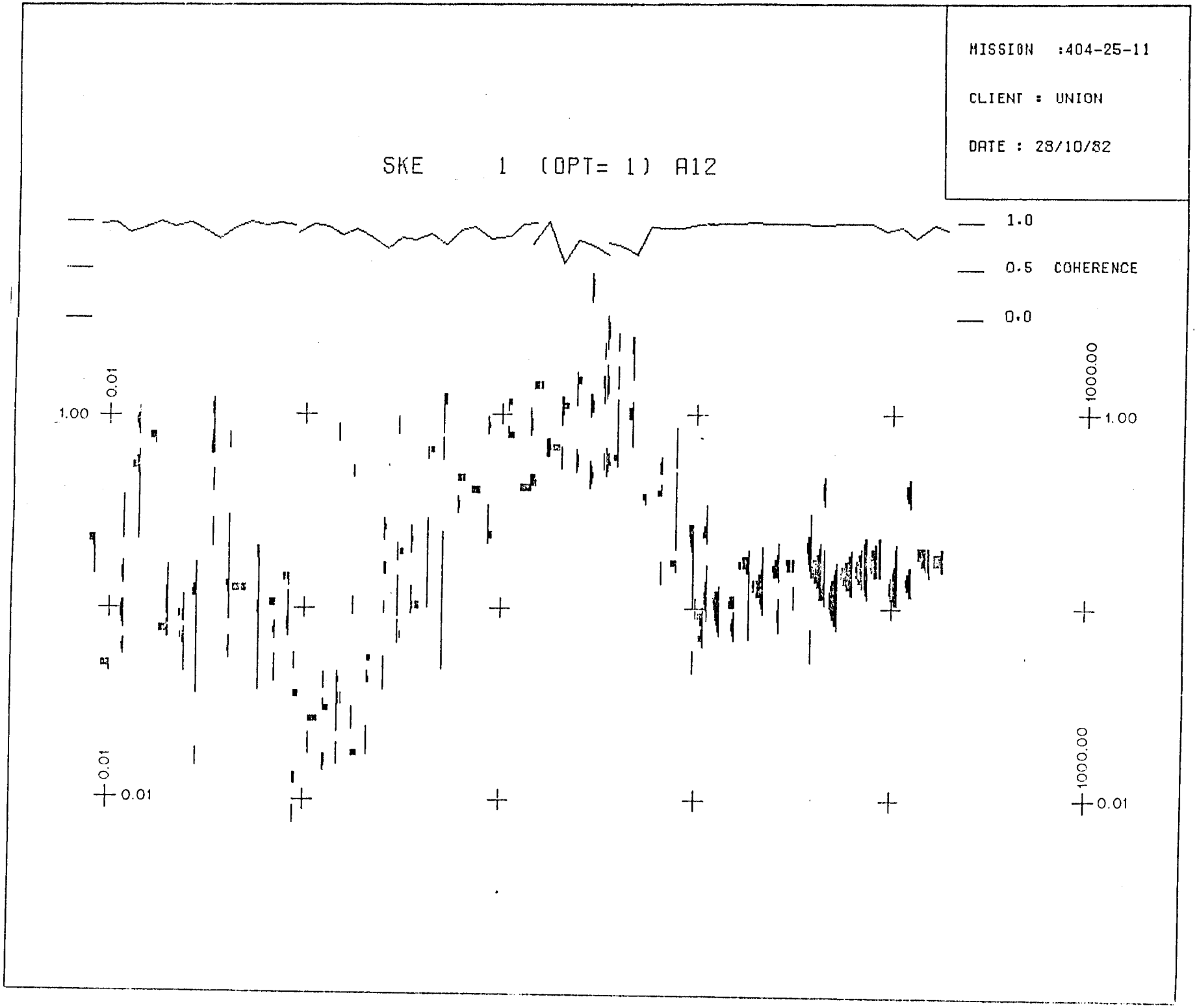


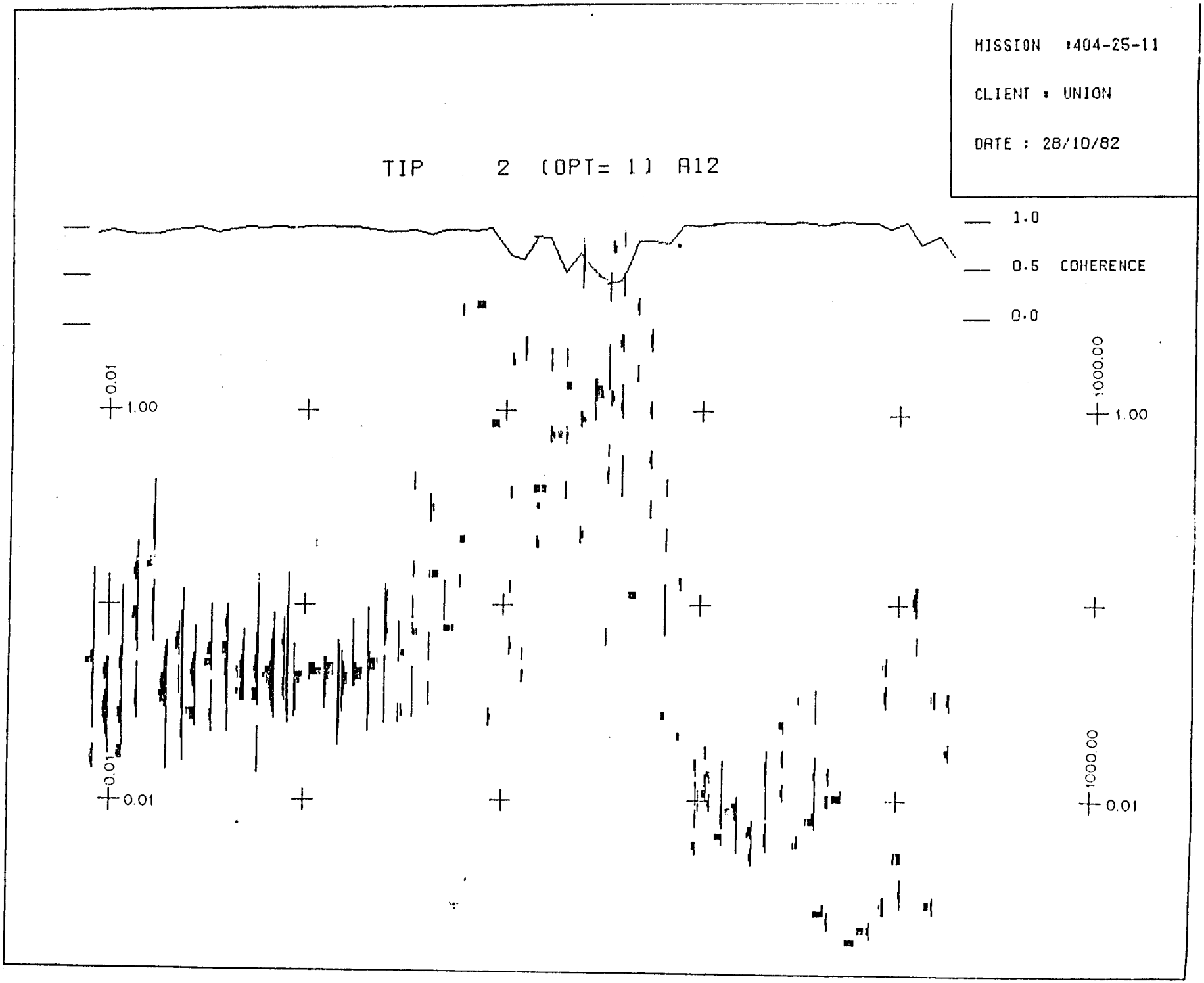

MISSION :404-25-11
CLIENT : UNION
DATE : 03/11/82
RHO YX 1 0080 0080 0080 (OPT= 1) A12
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

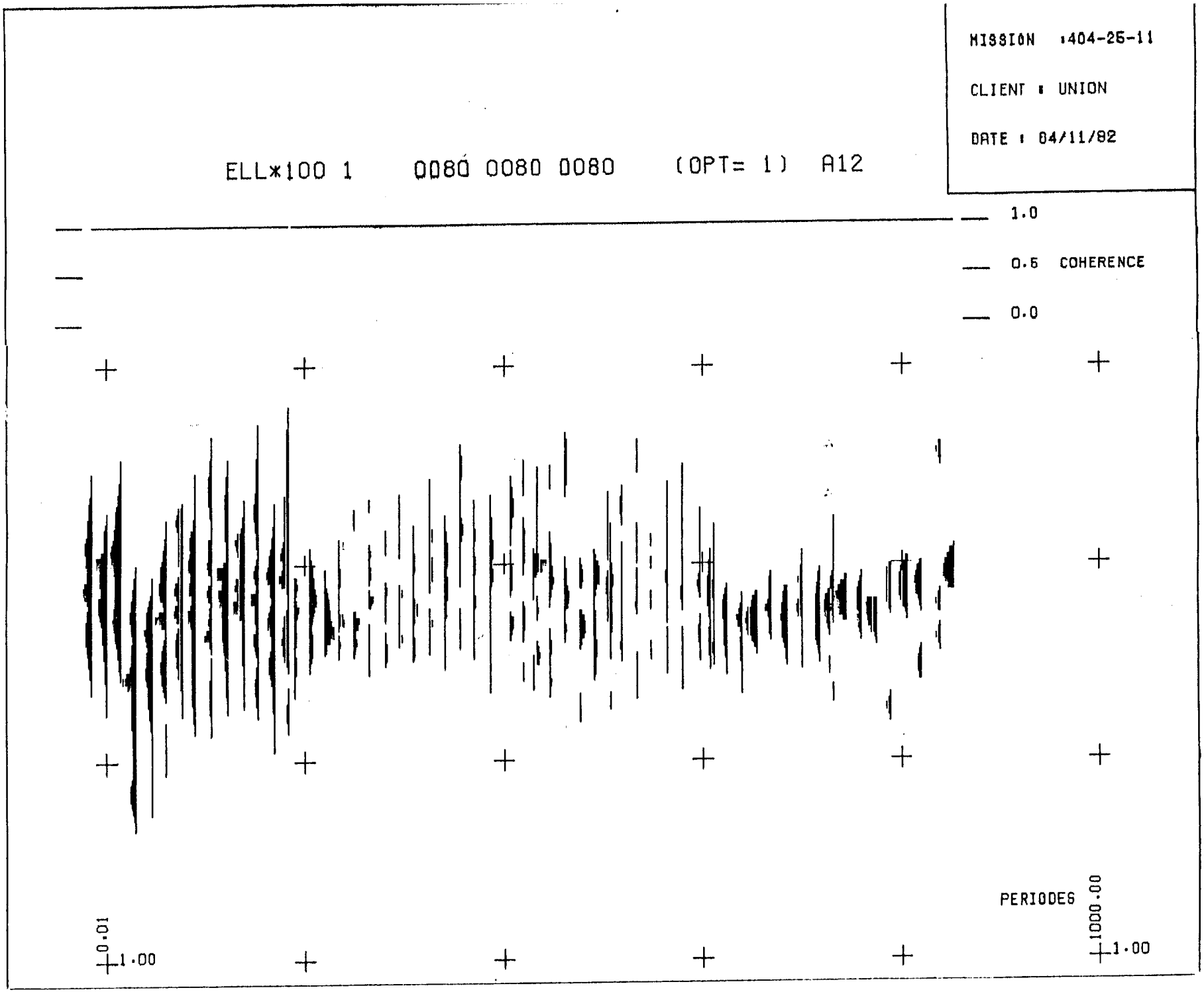

MISSION :404-25-11
CLIENT : UNION
DATE : 02/11/82
PHA YX 1 0080 0080 0080 (OPT= 1) A12
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 03/11/82
RHO XY 1 0080 0080 0080 (OPT= 1) A12
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 02/11/82
PHA XY 1 0080 0080 0080 (OPT= 1) A12
1.0
0.5 COHERENCE
0.0
0.01
45.00
100.00
45.00
0.01
45.00
100.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 28/10/82
SKE 1 (OPT= 1) A12
1.0
0.5 COHERENCE
0.0
1.00
0.01
0.01
0.01
1000.00
1.00
1000.00
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 28/10/82
TIP 2 (OPT= 1) A12
1.0
0.5 COHERENCE
0.0
0.01
1.00
0.01
0.01
1000.00
1.00
1000.00
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 04/11/82
ELL*100 1 0080 0080 0080 (OPT= 1) A12
1.0
0.5 COHERENCE
0.0
PERIODES
0.01
1.00
1000.00
1.00

STATION HIZ
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 160°
SKEW = 0.095
TIPPER = 0.086
COMBINAISON 1

XY

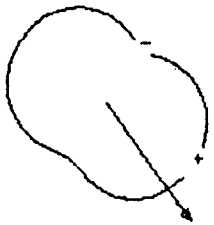
MODULE 2.[illegible] MAX. CENTRALE 10. AZIMUT DU MINIMUM 74°
MAXI 197.4 ANG ROT (MINIMUM) 70°

XX

MODULE 1.662 MAX. CENTRALE 8.1 AZIMUT DU MINIMUM 64°
MAXI 8.00 ANG ROT (MINIMUM) 60°

YZ

MODULE 2.[illegible]25 MAX. CENTRALE 8.01 AZIMUT DU MAXIMUM 124°
MAXI 8.082 ANG ROT (MAXIMUM) 80°



SKEW = 83.102
TIPPER = 0.086
COMBINAISON 2

XY

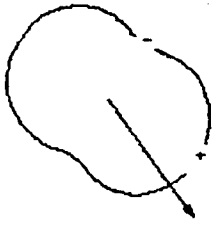
MODULE 3.[illegible]35 MAX. CENTRALE 10. AZIMUT DU MINIMUM 74°
MAXI 108.3 ANG ROT (MINIMUM) 70°

XX

MODULE 1.662 MAX. CENTRALE 8.1 AZIMUT DU MINIMUM 64°
MAXI 8.28 ANG ROT (MINIMUM) 60°

YZ

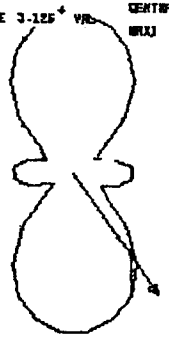
MODULE 2.[illegible]35 MAX. CENTRALE 8.01 AZIMUT DU MAXIMUM 124°
MAXI 8.083 ANG ROT (MAXIMUM) 80°



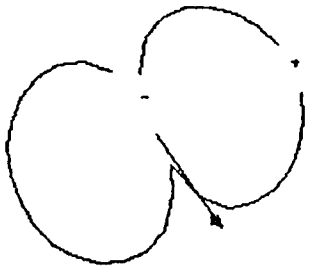
DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.50
AZIMUT EX 160gm
SKEW = 0.035
TIPPER = 0.203
COMBINAISON 1

XY

XX



YZ

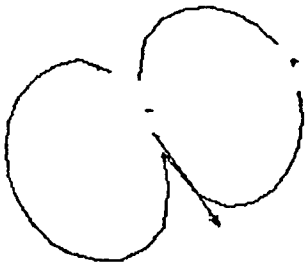


SKEW = 0.097
TIPPER = 0.203
COMBINAISON 2

XY

XX

YZ



DOMAINE HF

DECOUPAGE EN 59

TMIN = 10.04

TMAX = 10.08

AZIMUT EX 160m

SKEW = 10.016

TIPPER = 0.202

COMBINAISON 1

XY

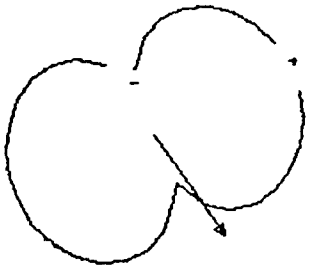
MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 64°
MAXI 230.6 ANG ROT (MINIMUM) 60°

XX

MODULE 3.125 VAL. CENTRALE 1. AZIMUT DU MINIMUM 64°
MAXI 5.4 ANG ROT (MINIMUM) 60°

YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 64°
MAXI 0.002 ANG ROT (MINIMUM) 60°



SKEW = 0.026

TIPPER = 0.204

COMBINAISON 2

XY

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 64°
MAXI 282.9 ANG ROT (MINIMUM) 60°

XX

MODULE 3.125 VAL. CENTRALE 1. AZIMUT DU MINIMUM 64°
MAXI 5.4 ANG ROT (MINIMUM) 60°

YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 64°
MAXI 0.005 ANG ROT (MINIMUM) 60°

UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 13

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/19 | 43-43 | B A | 42-45 | B-A | 44 | A-B |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 240 | 216 = 144°W |
| | Ey | 140 | 126 = 126°E |

| STRIKE from Exy, Hxy | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| | 81°E | 135 | 81 = 81E | XY | YX |
| STRIKE from Hz | 46°E | | | | |

## COMMENTS

### FIELD

clouds - no wind
Fair signal

### PROCESSING

Fair

35° ≠ between HOR and VERT strikes.

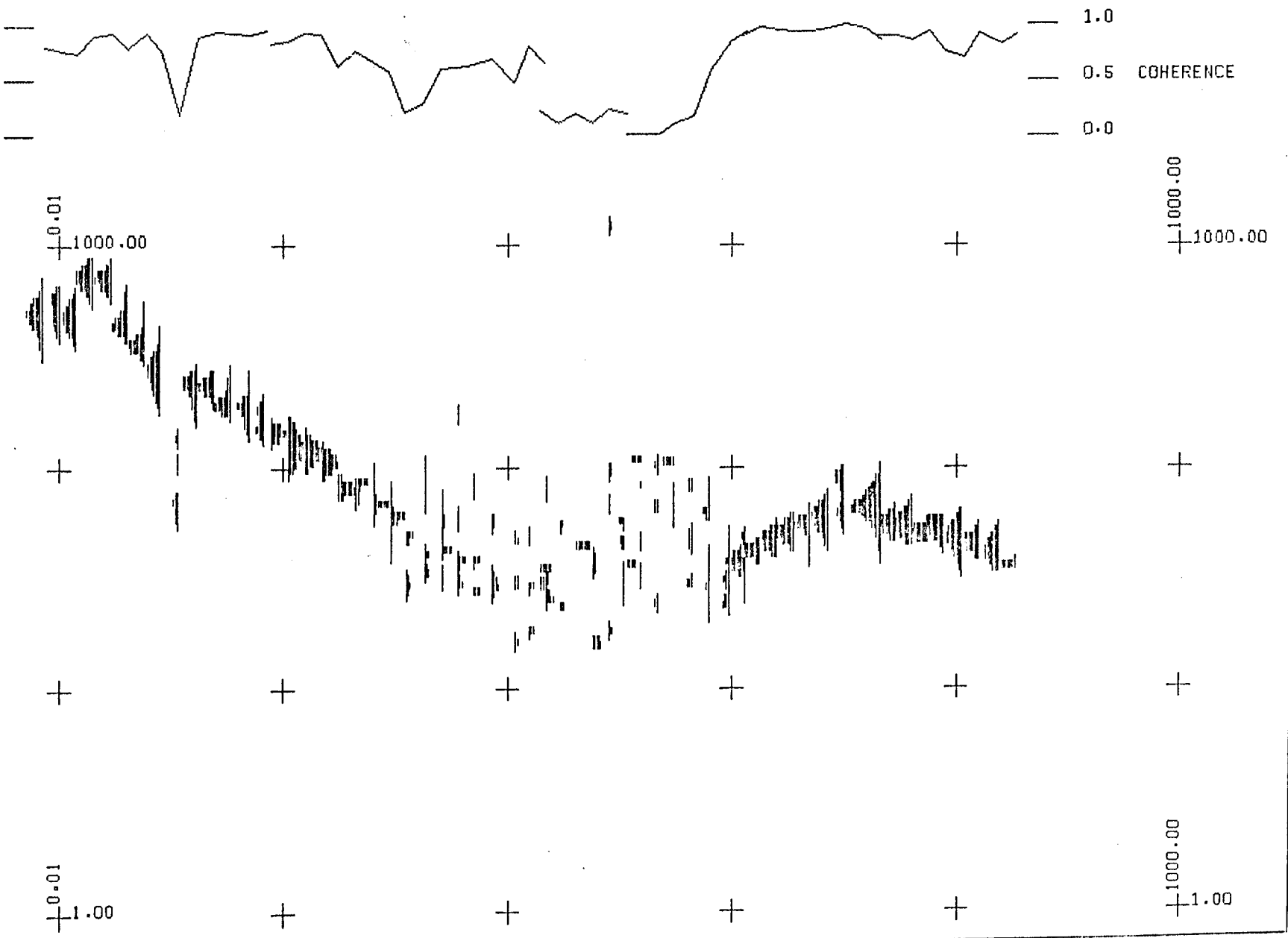
LF: $\rho E < \rho H$ / although E and H are not easily defined (cf supra)

MISSION :404-25-11

CLIENT : UNION

DATE : 09/11/82

RHO INV 1 (OPT= 1) B13

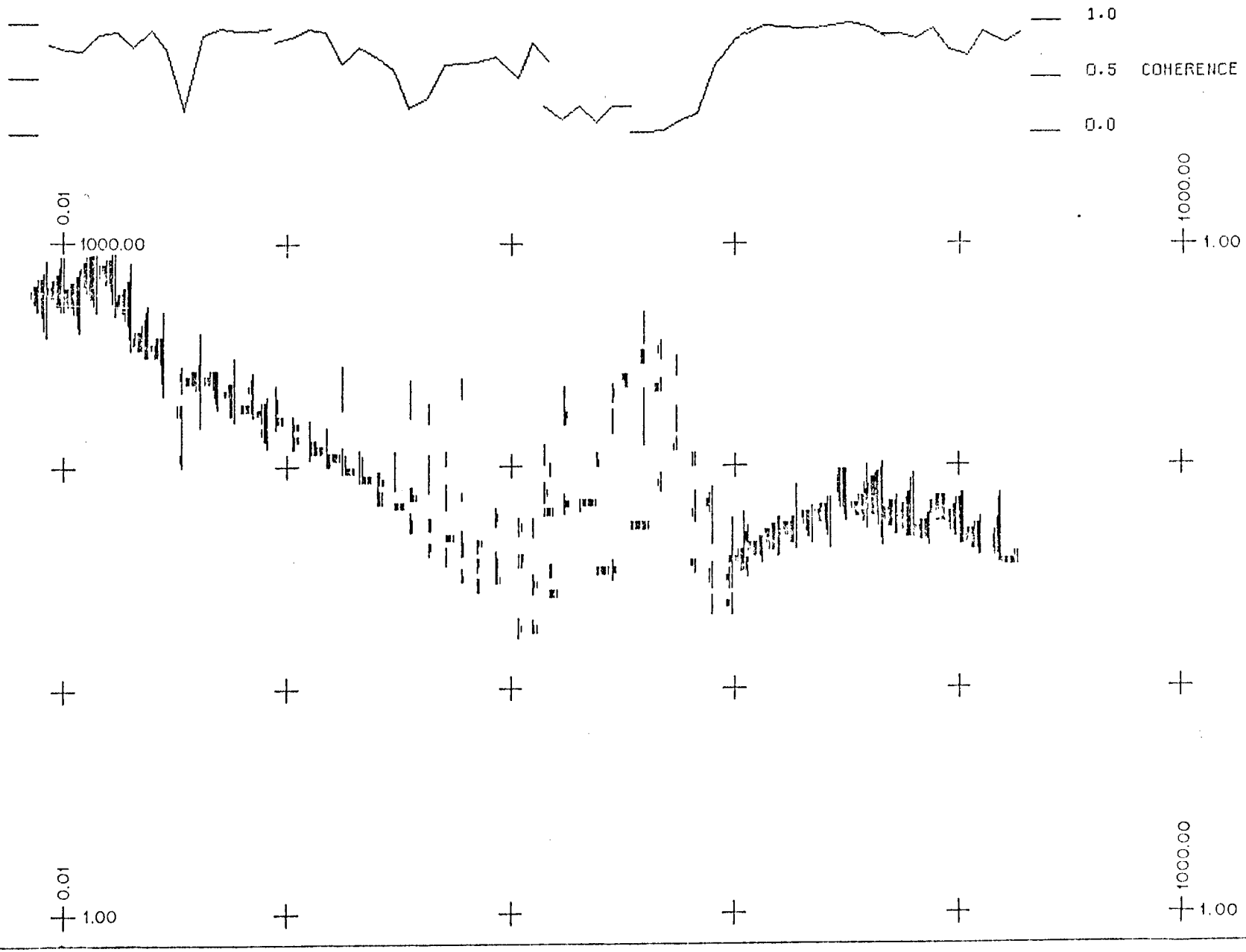


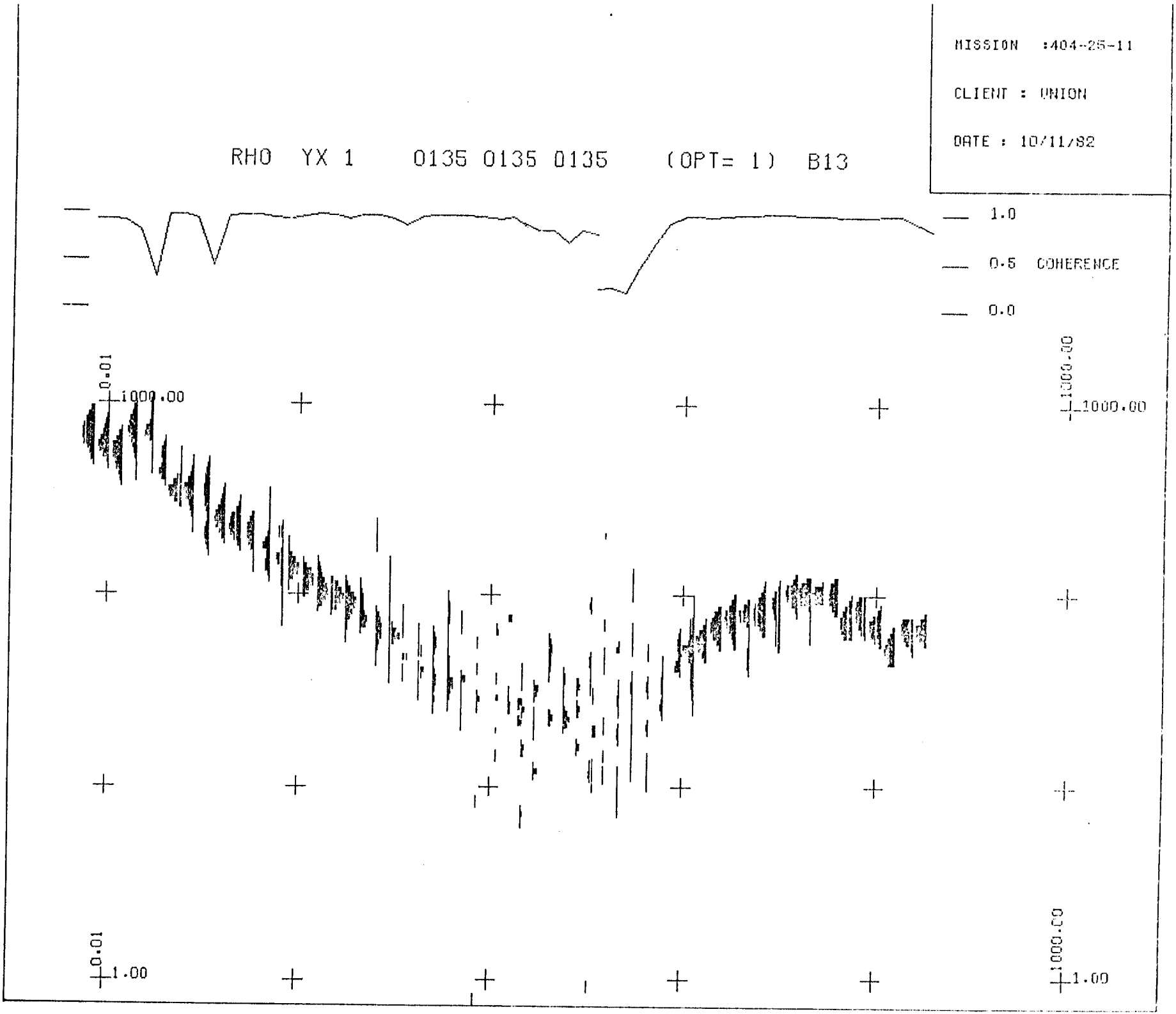
MISSION :404-25-11

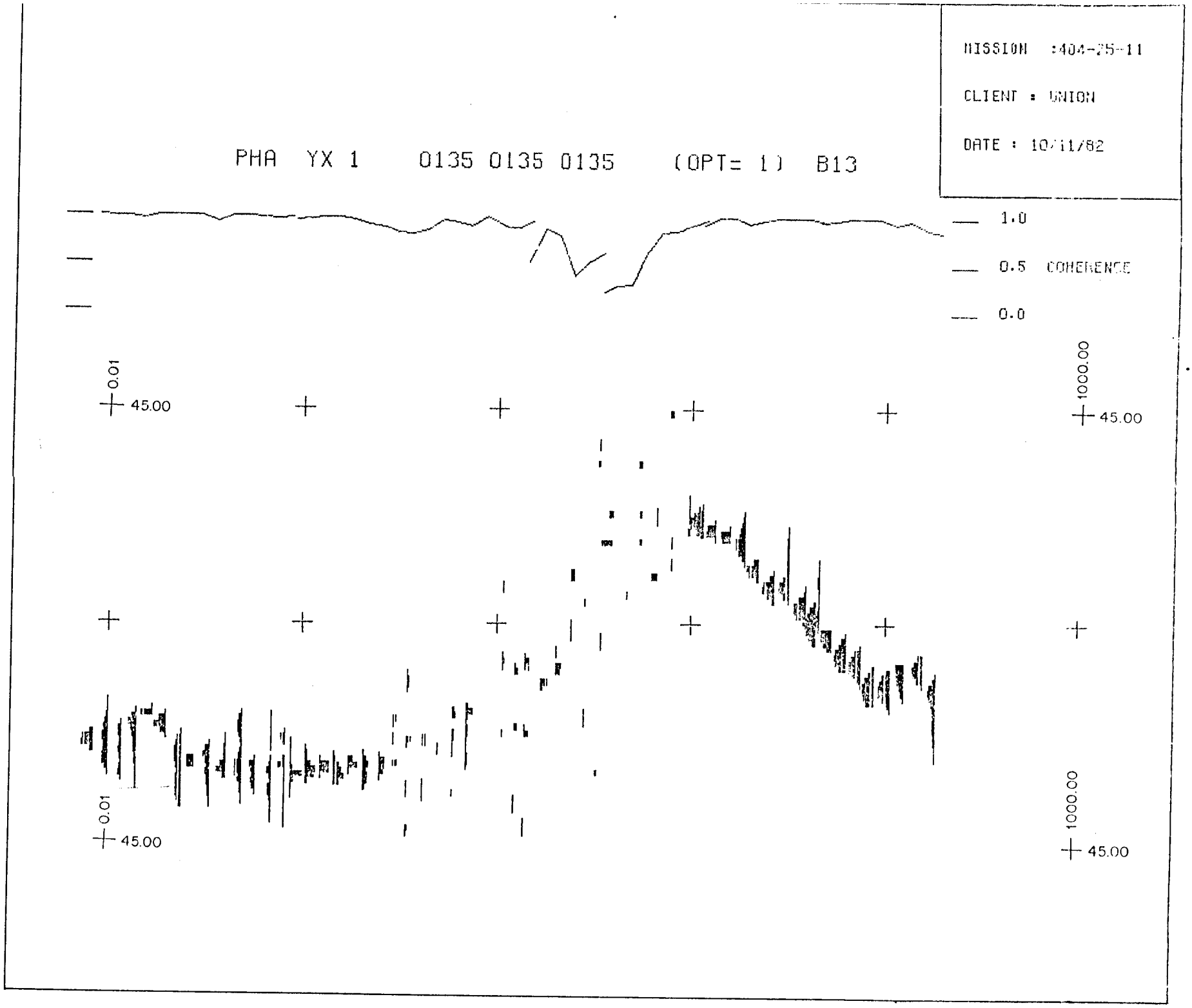
CLIENT : UNION

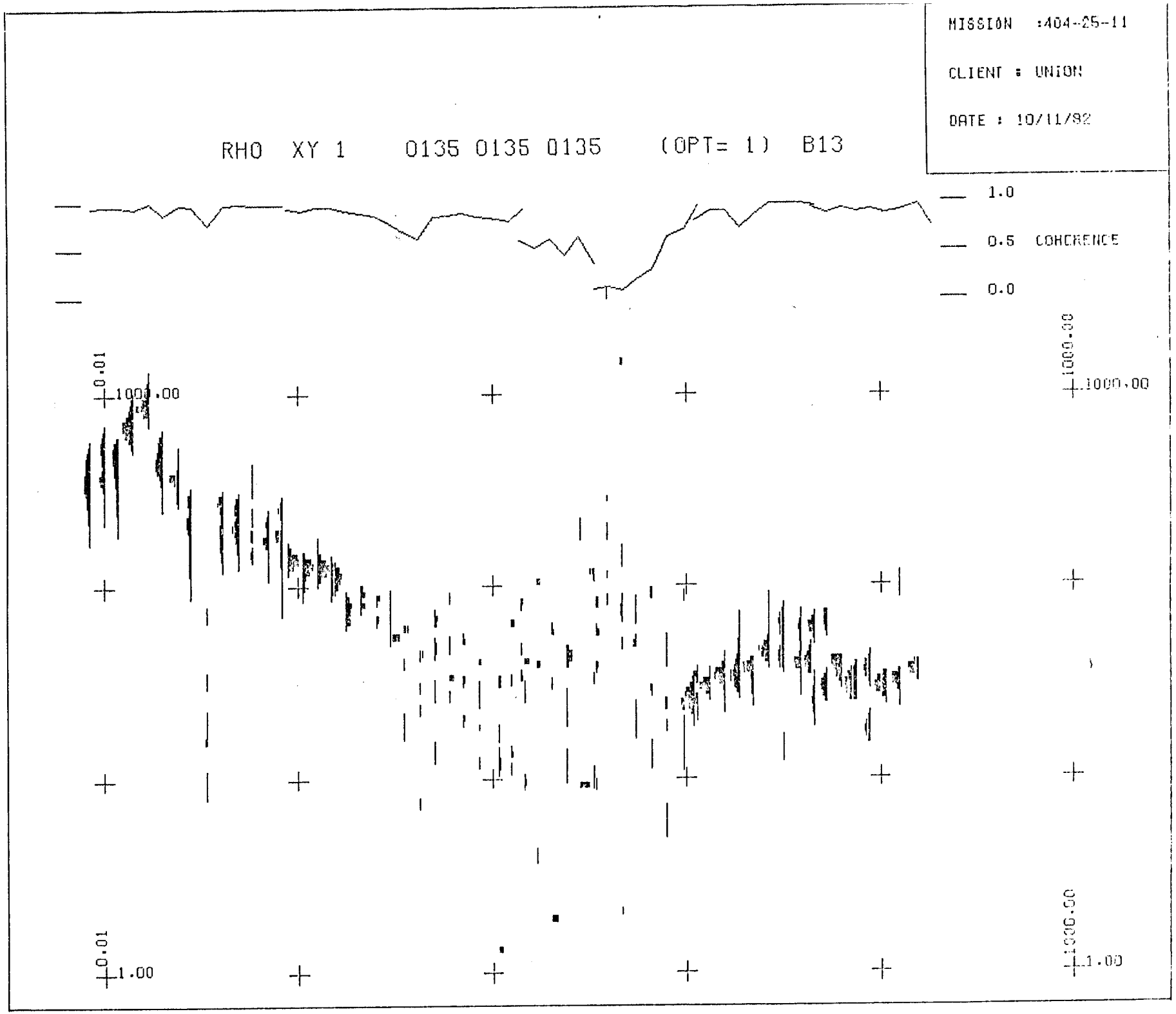
DATE : 09/11/82

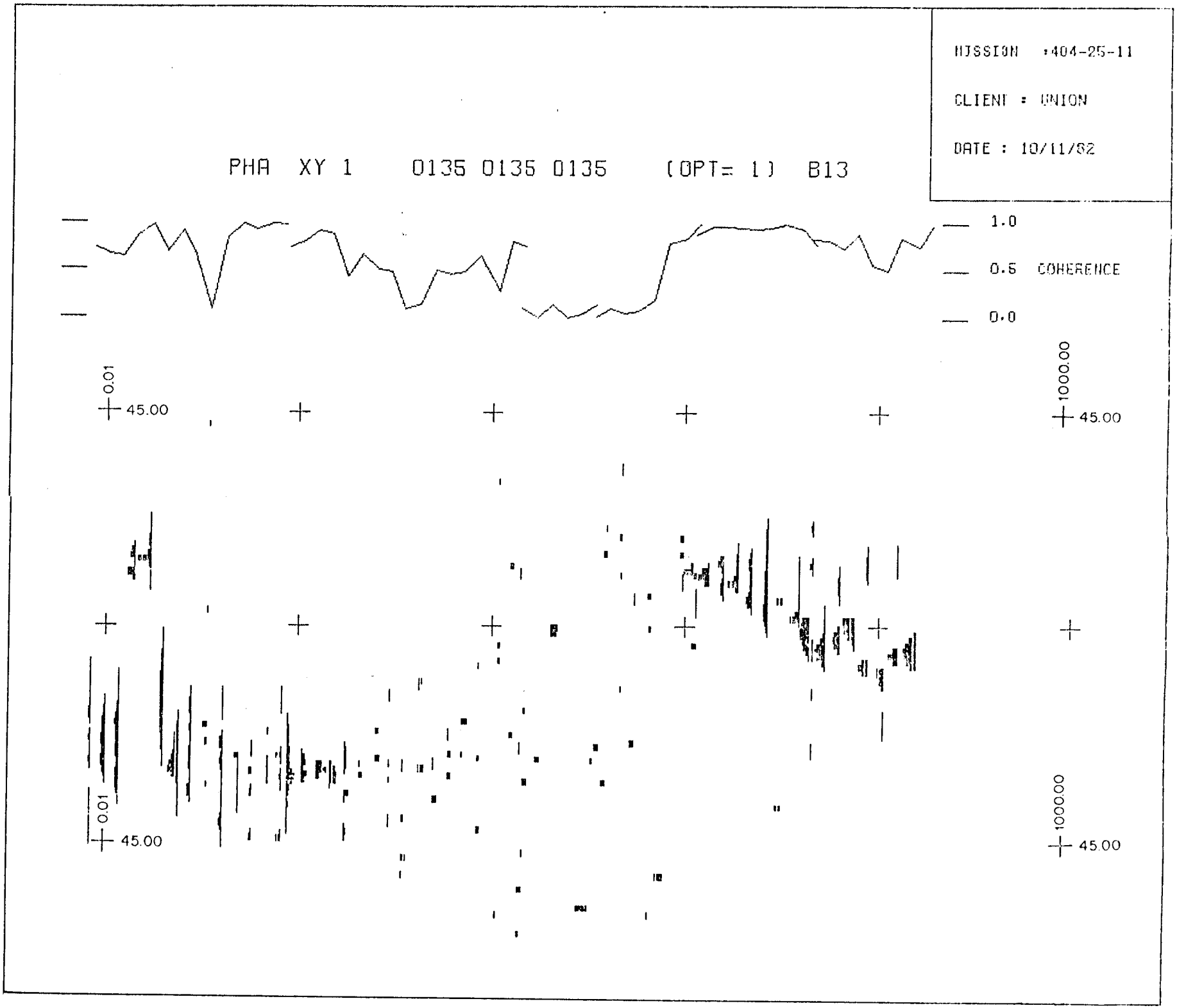
RHO INV 2 (OPT= 1) B13




MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
RHO YX 1 0135 0135 0135 (OPT= 1) B13
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
PHA YX 1 0135 0135 0135 (OPT= 1) B13
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
RHO XY 1 0135 0135 0135 (OPT= 1) B13
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
0.01
1.00
1.00

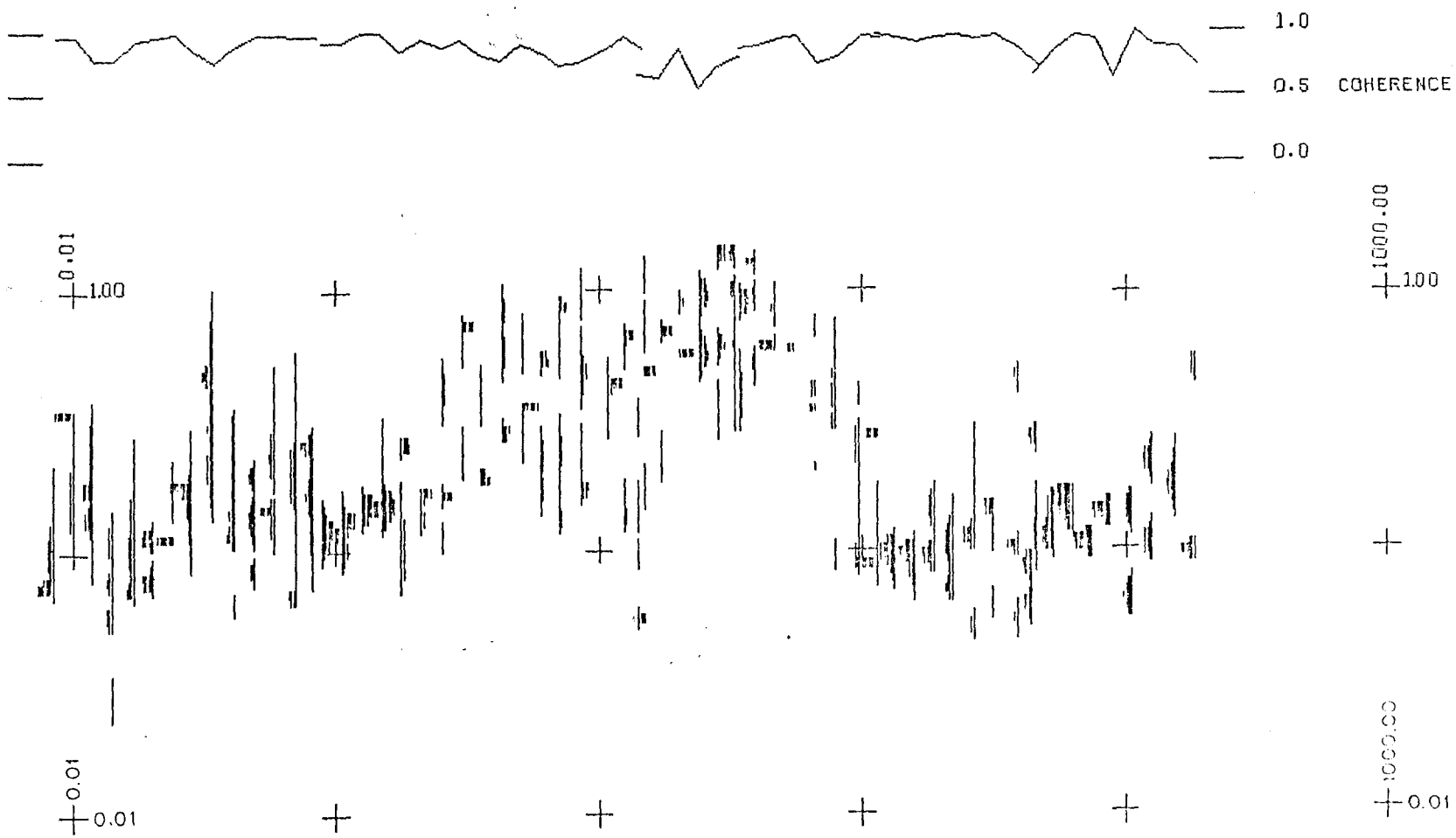

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
PHA XY 1 0135 0135 0135 (OPT= 1) B13
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00

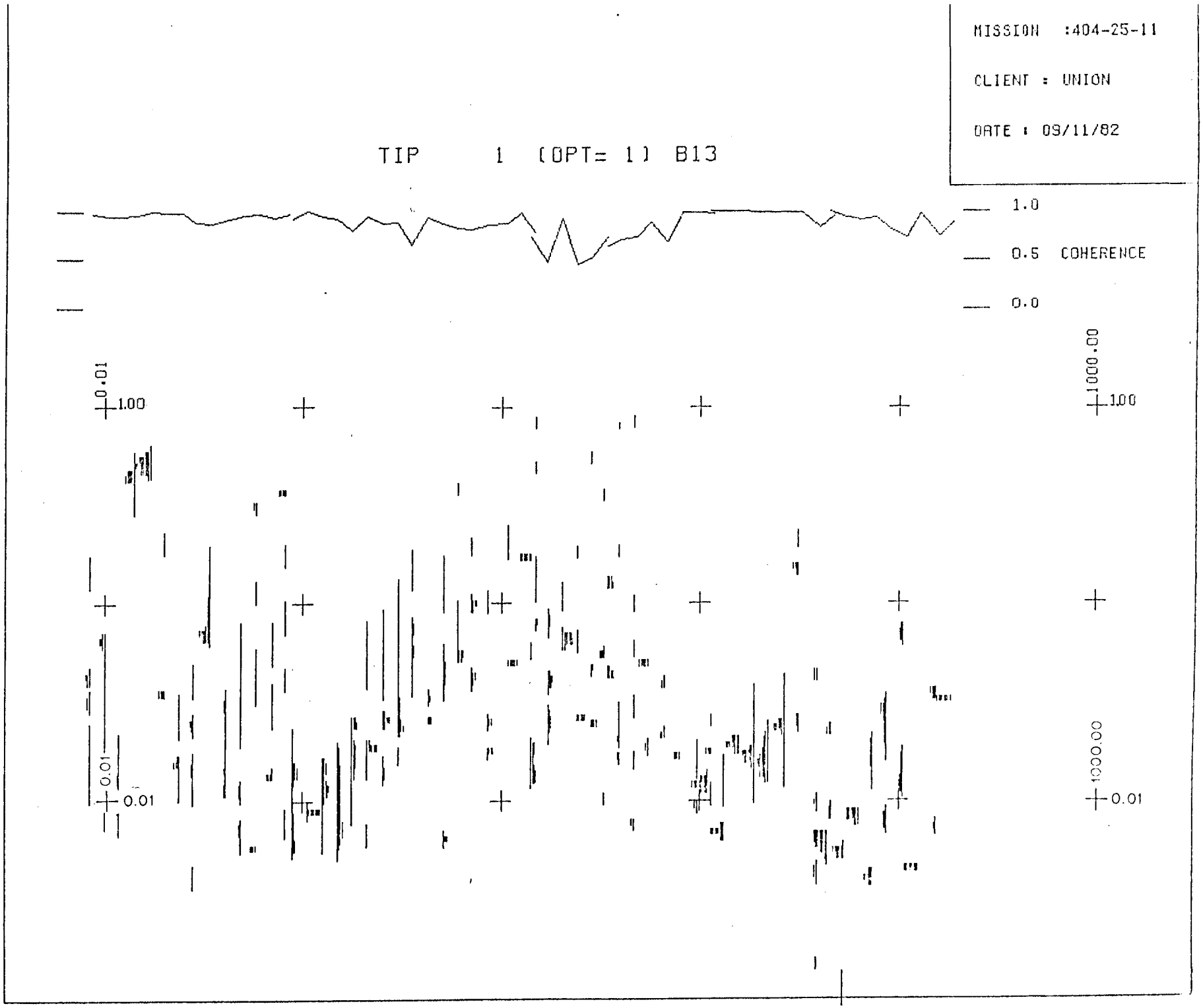
MISSION :404-25-11

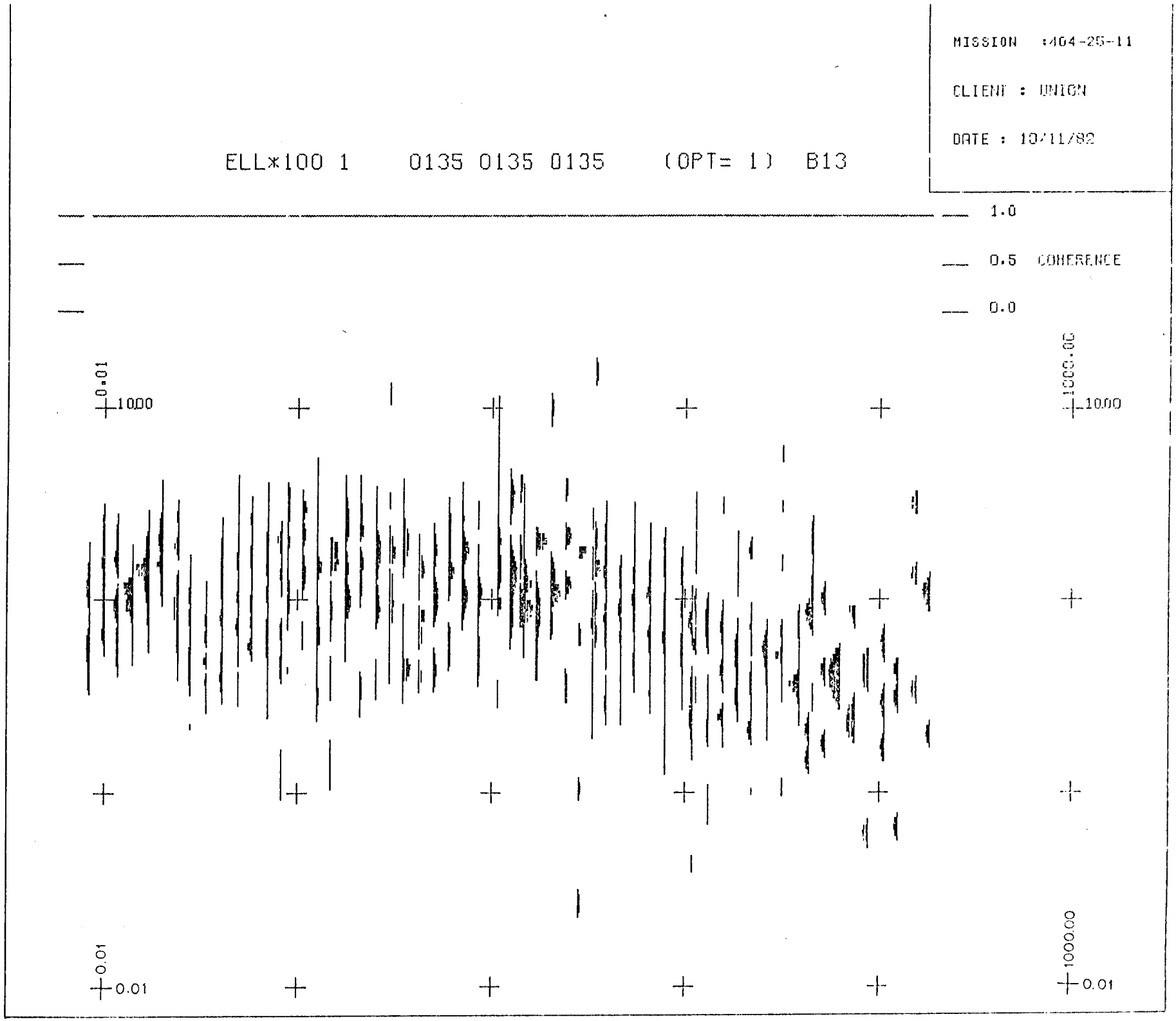
CLIENT : UNION

DATE : 09/11/92

SKE (OPT= 1) B13




MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
TIP 1 (OPT= 1) B13
1.0
0.5 COHERENCE
0.0
0.01
1.00
1000.00
1.00
0.01
0.01
1000.00
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
ELL*100 1 0135 0135 0135 (OPT= 1) B13
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
10.00
0.01
0.01
1000.00
0.01

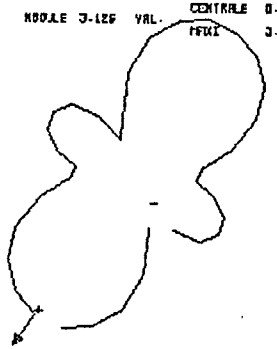
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 240DM
SKEW = 0.088
TIPPER = 0.115
COMBINAISON 1

XY

MODULE 3.12E VAL. CENTRALE 10. AZIMUT DU MINIMUM 74°
MAXI 82.0 ANG ROT (MINIMUM) 140°

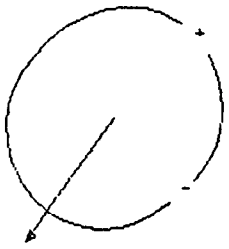
XX

MODULE 3.12E VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 166°
MAXI 3.02 ANG ROT (MINIMUM) 60°



YZ

MODULE 3.15E VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 46°
MAXI 0.038 ANG ROT (MAXIMUM) 120°

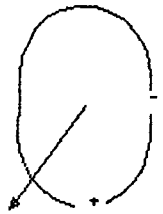


MISSION : 484-23-11
CLIENT : UNION
DATE : 08/11/82

SKEW = 0.105
TIPPER = 0.114
COMBINAISON 2

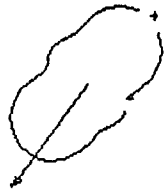
XY

MODULE 3.13E VAL. CENTRALE 10. AZIMUT DU MINIMUM 85°
MAXI 70.7 ANG ROT (MINIMUM) 150°



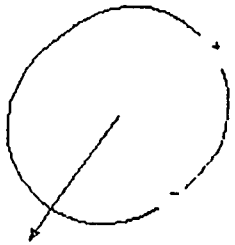
XX

MODULE 1.68E VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 176°
MAXI 3.33 ANG ROT (MINIMUM) 100°



YZ

MODULE 3.19E VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 80°
MAXI 0.047 ANG ROT (MAXIMUM) 150°



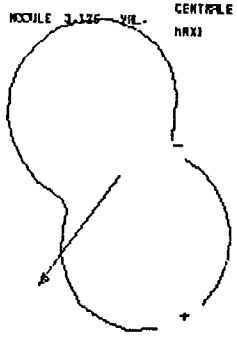
STATION DIS
DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.50
AZIMUT EX 240°
SKEW = 0.216
TIPPER = 0.085
COMBINAISON 1

XY

MODULE 3.115 VAL. CENTRALE 300. AZIMUT DU MINIMUM 108°
MAXI 210.3 RHO ROT (MINIMUM) 20°

XX

MODULE 3.125 VAL. CENTRALE 1. AZIMUT DU MINIMUM 68°
MAXI 21.8 RHO ROT (MINIMUM) 158°



YZ

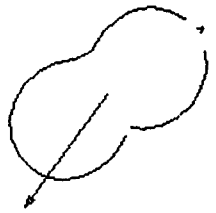
MODULE 3.195 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 208°
MAXI 0.088 RHO ROT (MAXIMUM) 10°

MISSION : 404-25-31
CLIENT : UNION
DATE : 08/11/82

SKEW = 0.085
TIPPER = 0.102
COMBINAISON 2

XY

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 148°
MAXI 666.9 RHO ROT (MINIMUM) 70°

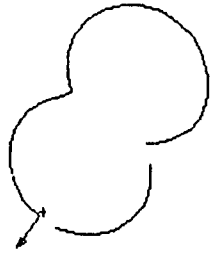


XX

MODULE 1.952 VAL. CENTRALE 1. AZIMUT DU MINIMUM 65°
MAXI 84.5 RHO ROT (MINIMUM) 155°

YZ

MODULE 3.105 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 215°
MAXI 0.108 RHO ROT (MAXIMUM) 0°



STATION B13
DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 240°
SKEW = 0.137
TIPPER = 0.069
COMBINAISON 1

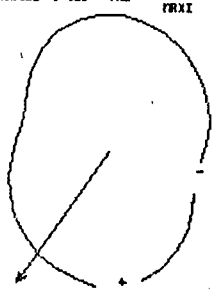
MISSION : 404-23-31
CLIENT : UNION
DATE : 08/11/81

XY

MODULE 3.126 VAL. CENTRALE 100. AZIMUT DU MINIMUM 108°
MAXI 124.6 ANG ROT (MINIMUM) 110°

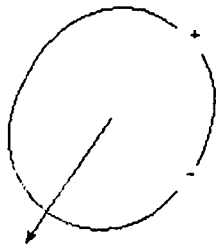
XX

MODULE 3.126 VAL. CENTRALE 1. AZIMUT DU MINIMUM 105°
MAXI 14.2 ANG ROT (MINIMUM) 110°



YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 48°
MAXI 0.081 ANG ROT (MAXIMUM) 170°



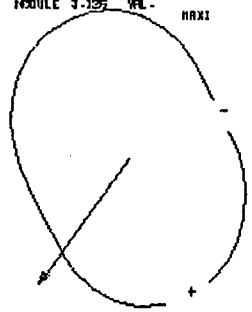
SKEW = 0.155
TIPPER = 0.100
COMBINAISON 2

XY

MODULE 3.126 VAL. CENTRALE 100. AZIMUT DU MINIMUM 148°
MAXI 250.5 ANG ROT (MINIMUM) 70°

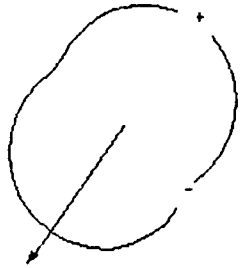
XX

MODULE 3.126 VAL. CENTRALE 1. AZIMUT DU MINIMUM 55°
MAXI 19.1 ANG ROT (MINIMUM) 150°



YZ

MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 36°
MAXI 0.100 ANG ROT (MAXIMUM) 103°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 14

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/19 | 38<br>41 | A<br>B | 37<br>40 | A<br>B | 39 | A-B |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 10 | 9 = 9°E |
| | Ey | 310 | 279 = 81°W |

| STRIKE from Exy, Hxy | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| | 19°E | 170 | 199 = 161W | XY | YX |
| STRIKE from Hz | 38°E | | | | |

## COMMENTS

### FIELD

clouds - no wind
Fair signal

### PROCESSING

Fair

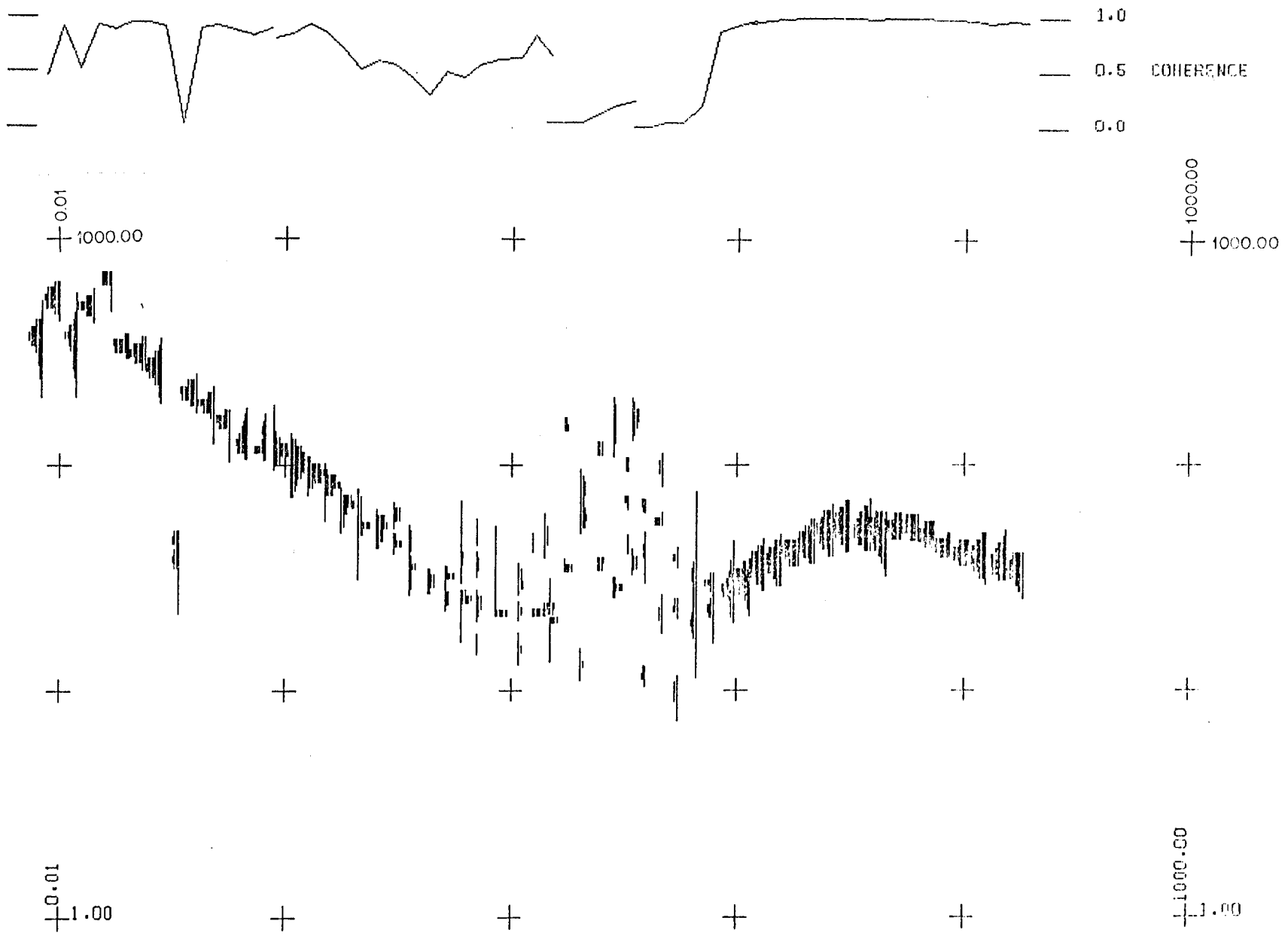
LF: $\rho E < \rho H$

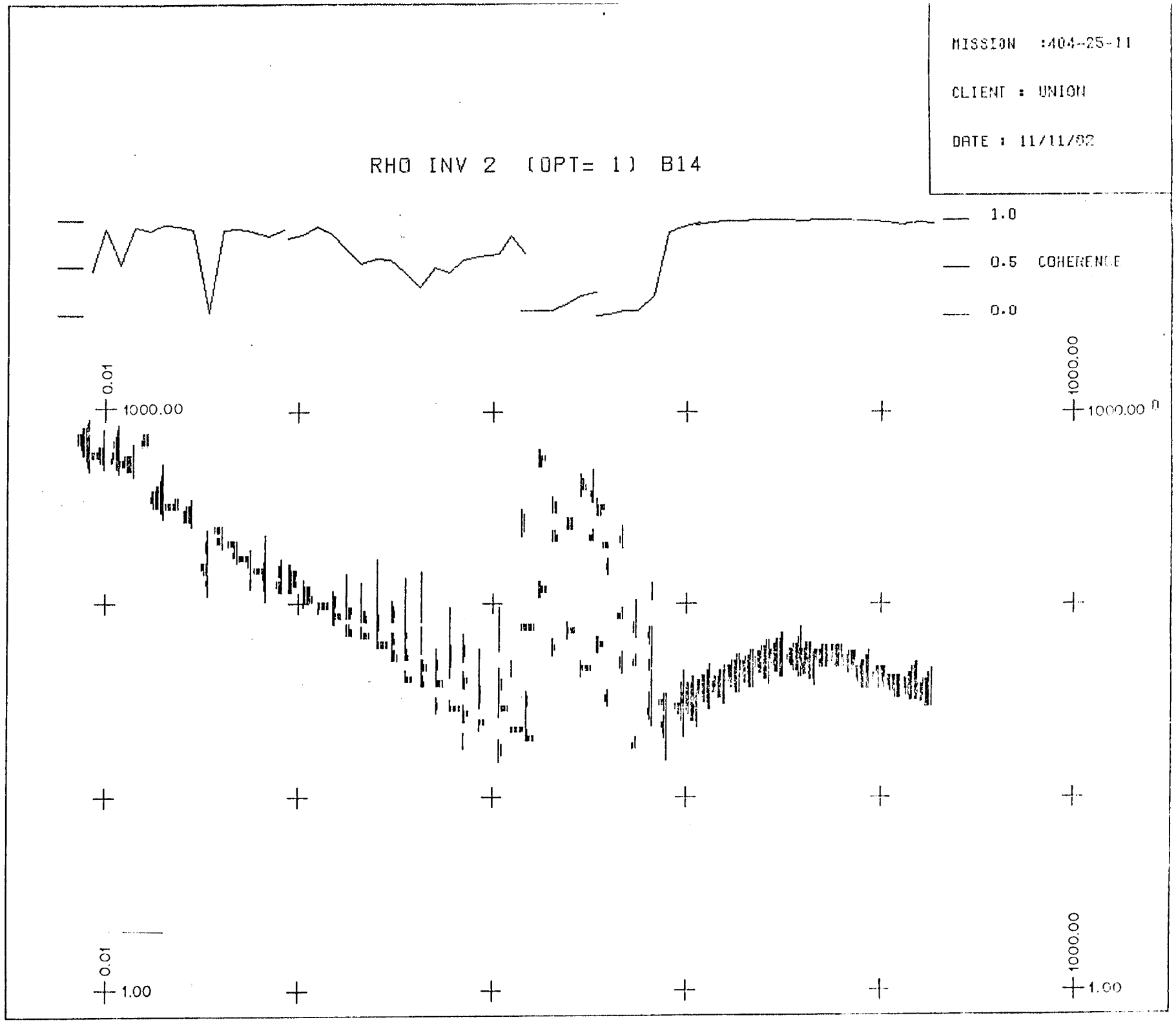
MISSION :404-25-11

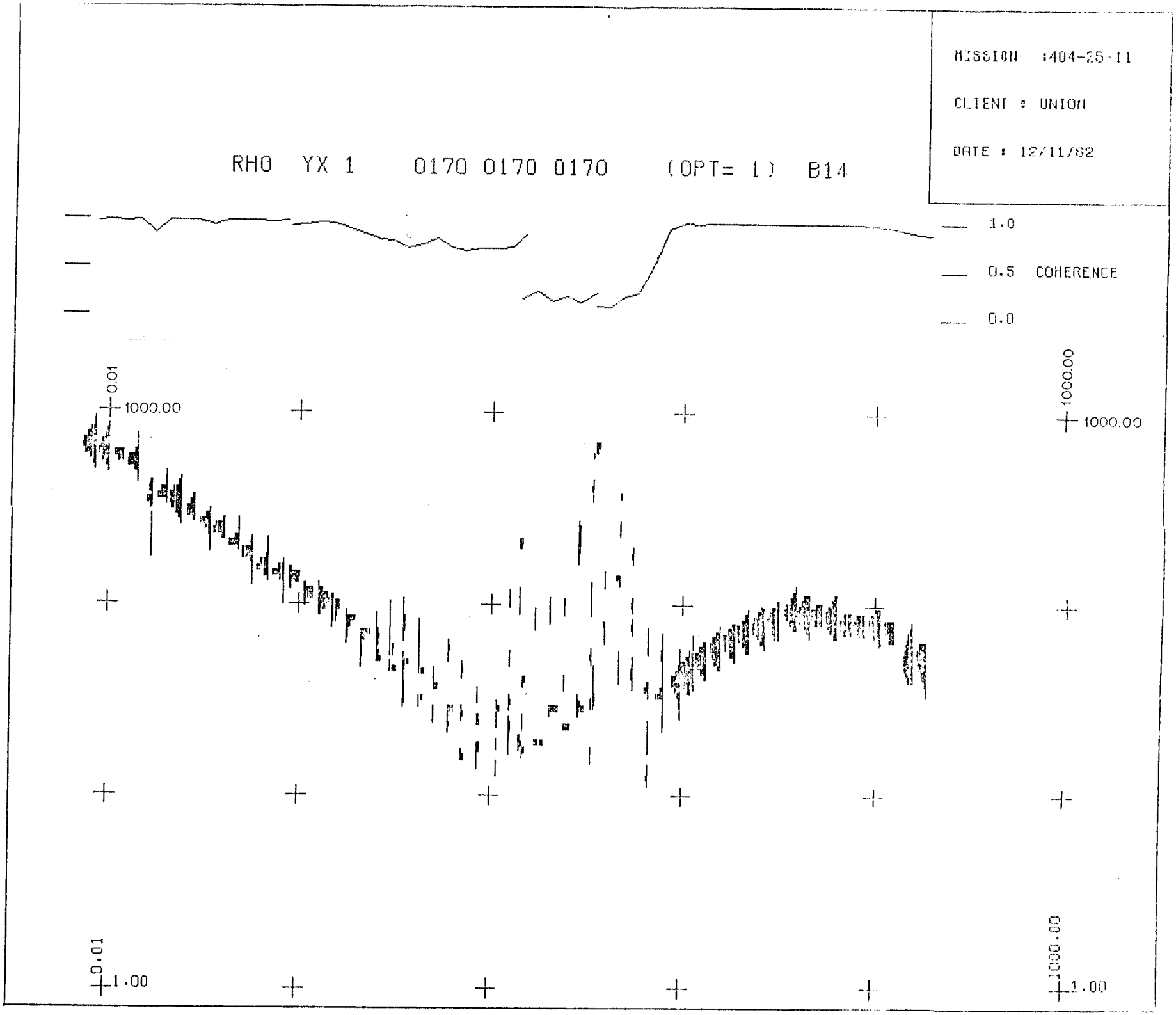
CLIENT : UNION

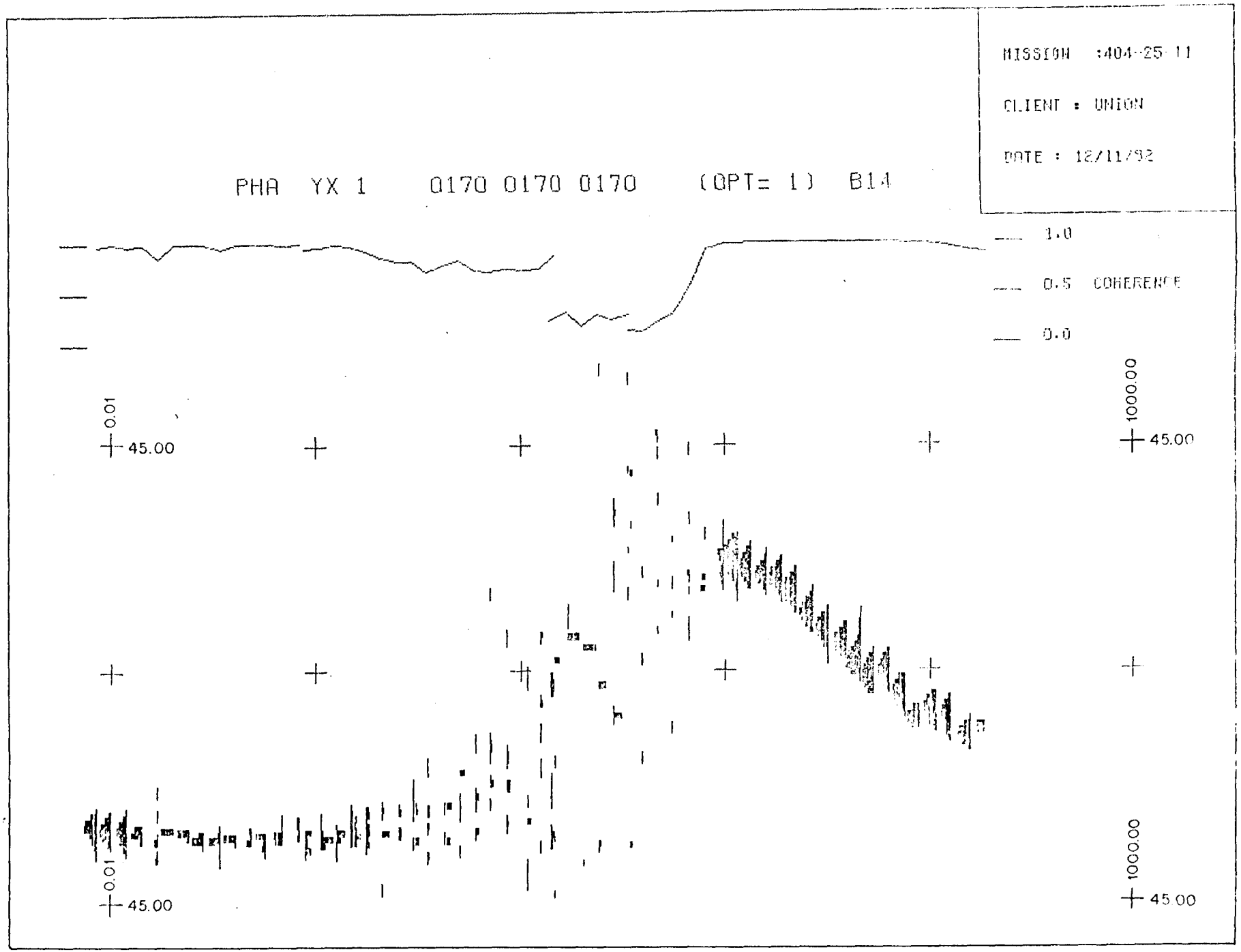
DATE : 11/11/82

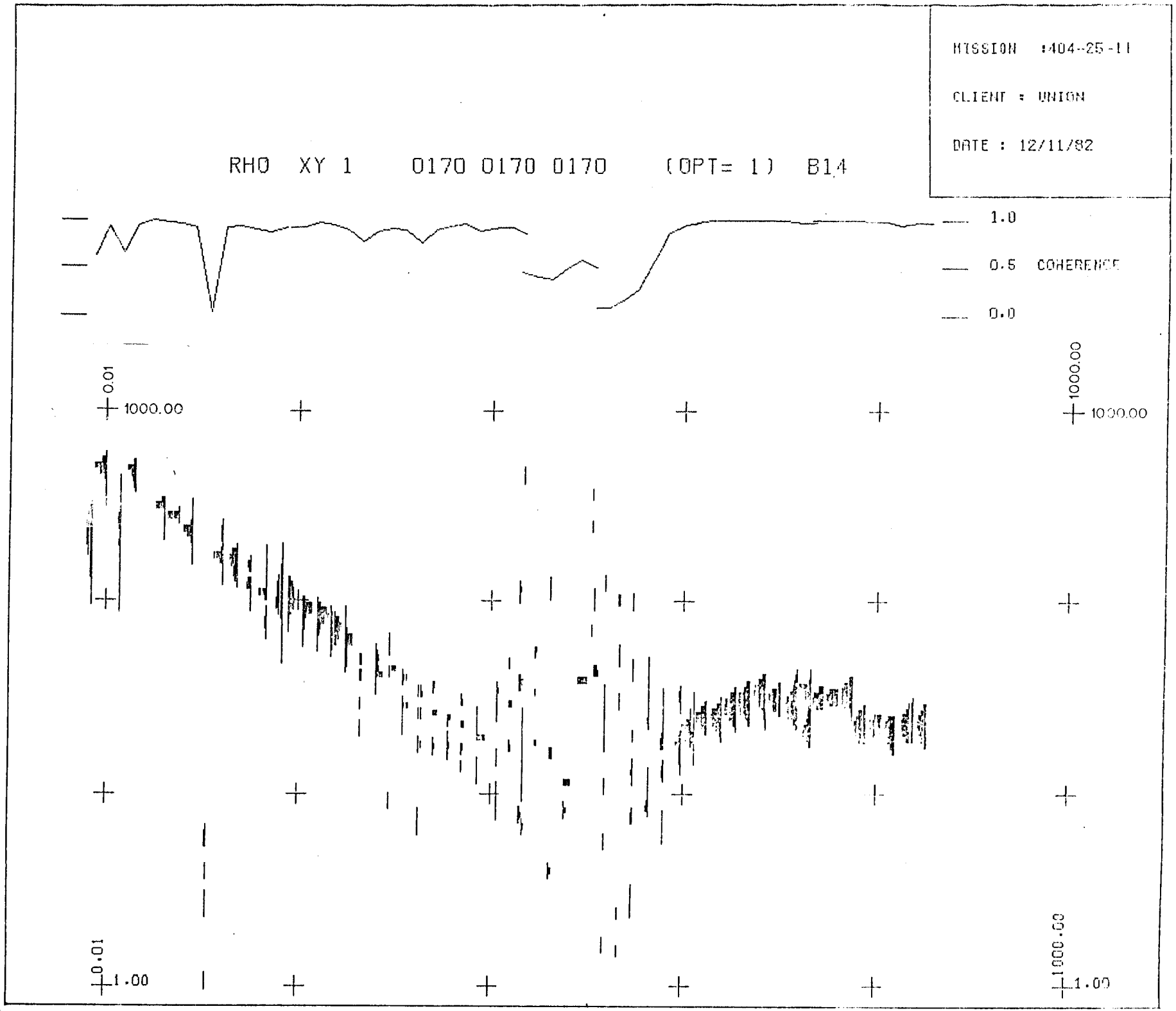
RHO INV 1 (OPT= 1) B14

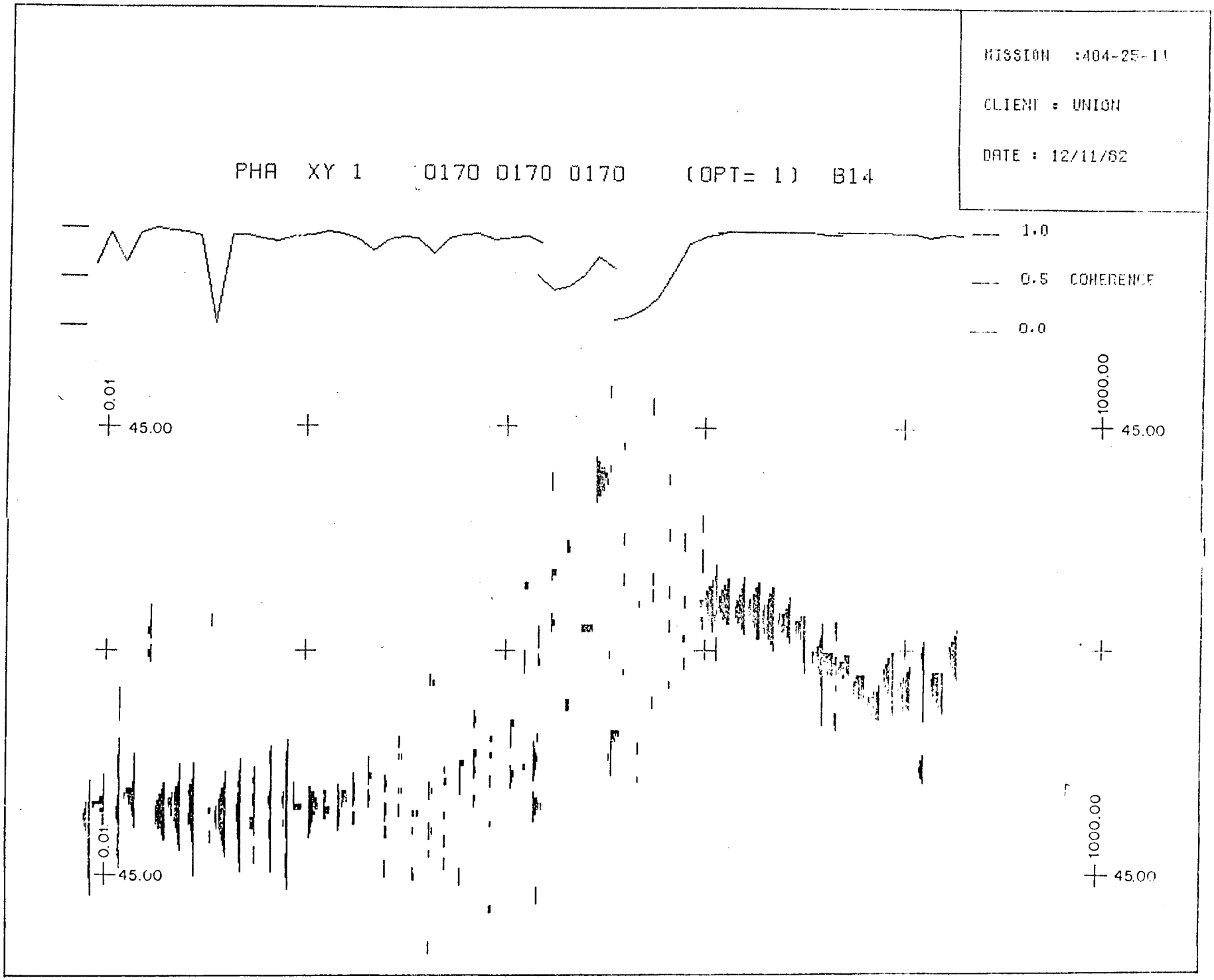


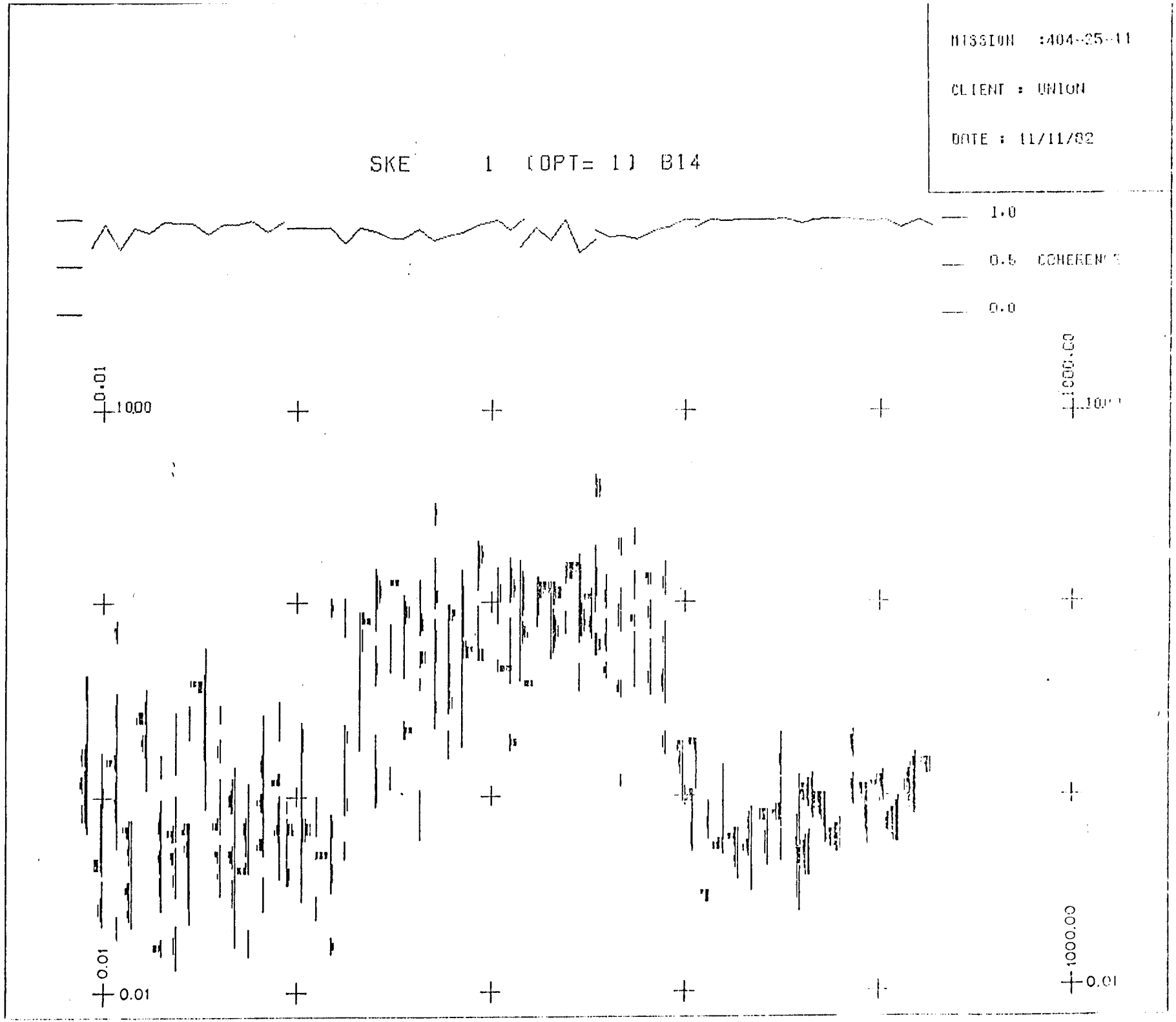

MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/82
RHO INV 2 (OPT= 1) B14
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
RHO YX 1 0170 0170 0170 (OPT= 1) B14
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/92
PHA YX 1 0170 0170 0170 (OPT= 1) B14
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
RHO XY 1 0170 0170 0170 (OPT= 1) B14
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

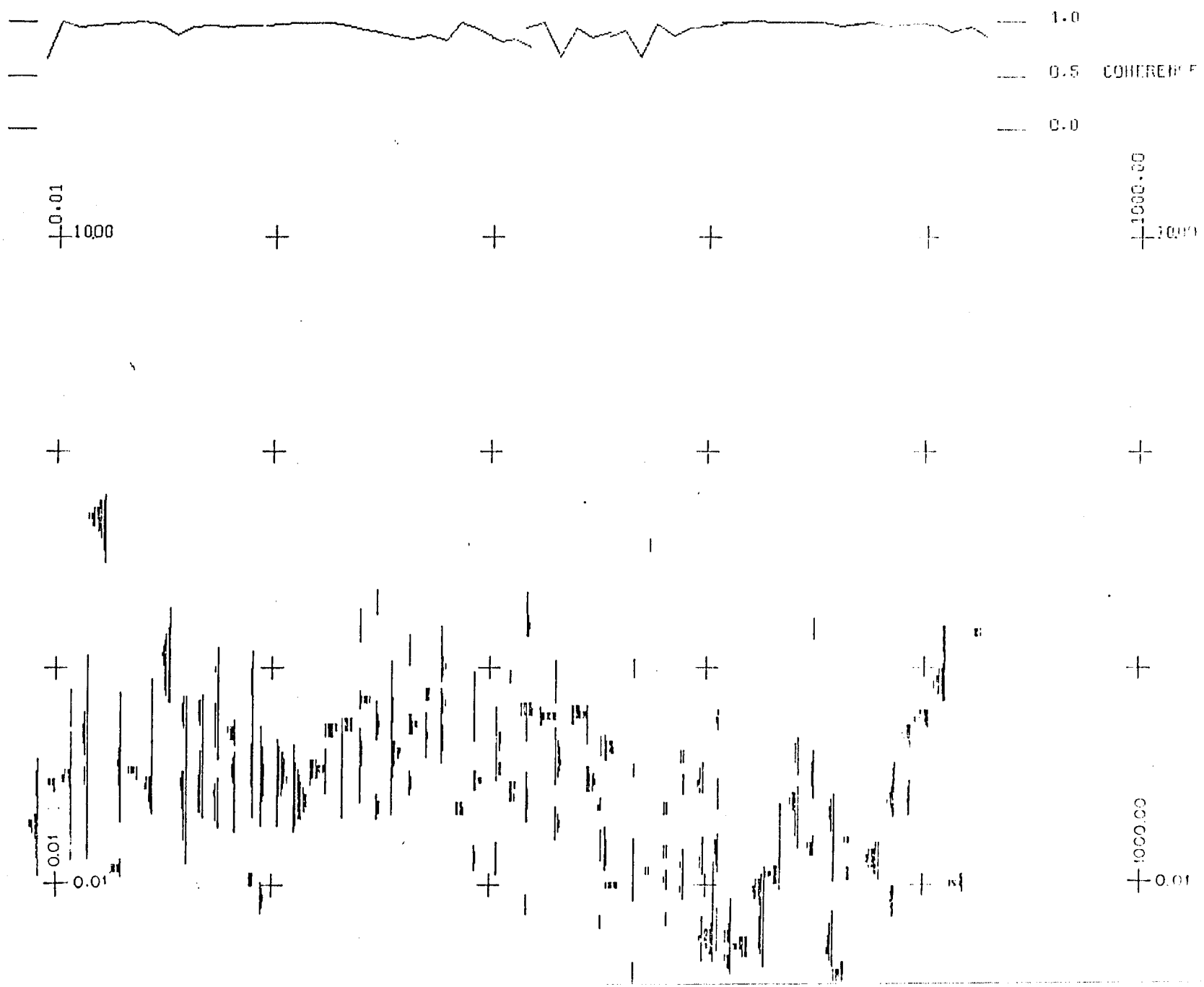

MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
PHA XY 1 0170 0170 0170 (OPT= 1) B14
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 11/11/82
SKE 1 (OPT= 1) B14
1.0
0.5 COHEREN
0.0
0.01
10.00
1000.00
0.01
0.01
1000.00
0.01

CLIENT : UNION

DATE : 11/11/92

TIP (OPT= 1) B14

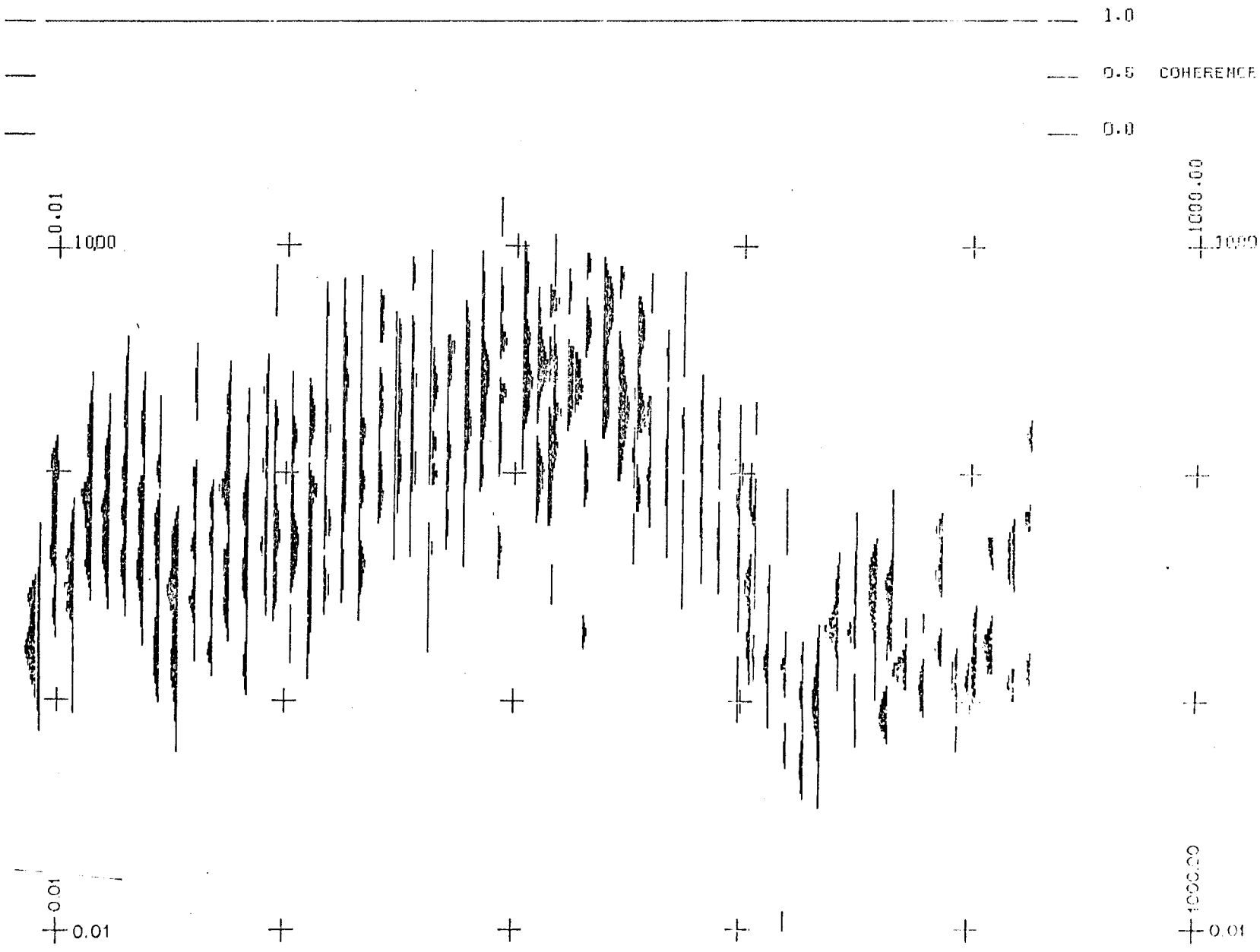


MISSION :404-25-11

CLIENT : UNION

DATE : 12/11/82

ELL 1 0170 0170 0170 (OPT= 1) B14



STATION 014
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 10°
SKEW = 0.043
TIPPER = 0.094
COMBINAISON 1

MISSION : 484-85-11
CLIENT : UNION
DATE : 11/11/82

SKEW = 0.038
TIPPER = 0.098
COMBINAISON 2

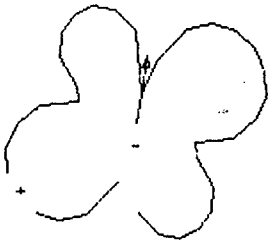
XY

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 100°
MAXI 60.8 ANG ROT (MINIMUM) 170°

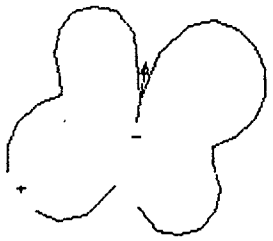
MODULE 3.126 VAL. CENTRALE 10. AZIMUT DU MINIMUM 100°
MAXI 67.6 ANG ROT (MINIMUM) 170°

XX

MODULE 1.952 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 130°
MAXI 2.742 ANG ROT (MINIMUM) 160°

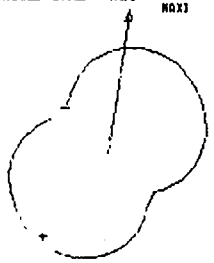


MODULE 1.662 VAL. CENTRALE 0.01 AZIMUT DU MINIMUM 100°
MAXI 2.630 ANG ROT (MINIMUM) 100°



YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 210°
MAXI 0.001 ANG ROT (MAXIMUM) 160°



MODULE 3.126 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 220°
MAXI 0.026 ANG ROT (MAXIMUM) 140°

STATION 014
DOMAINE NF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 10gm
SKEW = 0.045
TIPPER = 0.173
COMBINAISON 1

MISSION : 454-25-11
CLIENT : UNION
DATE : 08/11/82

SKEW = 0.117
TIPPER = 0.161
COMBINAISON 2

XY

MODULE 3.135 VAL. CENTRALE 300. AZIMUT DU MINIMUM 330°
MAXI 301.0 ANG ROT (MINIMUM) 30°

XY

MODULE 9.156 VAL. CENTRALE 100. AZIMUT DU MINIMUM 340°
MAXI 661.0 ANG ROT (MINIMUM) 20°

XX

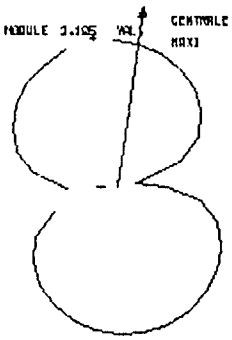
MODULE 3.135 VAL. CENTRALE 1. AZIMUT DU MINIMUM 350°
MAXI 10.4 ANG ROT (MINIMUM) 10°

XX

MODULE 9.781 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 350°
MAXI 175.80 ANG ROT (MINIMUM) 10°

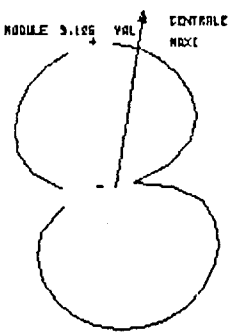
YZ

MODULE 3.135 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 340°
MAXI 0.174 ANG ROT (MAXIMUM) 20°



YZ

MODULE 9.156 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 340°
MAXI 0.182 ANG ROT (MAXIMUM) 20°



STATION D14
DOMAINE HF
DECOUPAGE EN 46
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 10gm
SKEW = 0.056
TIPPER = 0.166
COMBINAISON 1

MISSION : 404-ES-LL
CLIENT : UNION
DATE : 08/11/83

SKEW = 0.031
TIPPER = 0.155
COMBINAISON 2

XY

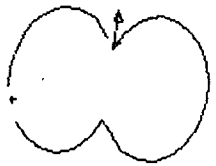
MODULE 3.155 VAL. CENTRALE 100. AZIMUT DU MINIMUM 100°
MAXI 214.4 ANG ROT (MINIMUM) 190°

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 160°
MAXI 266.1 ANG ROT (MINIMUM) 170°

XX

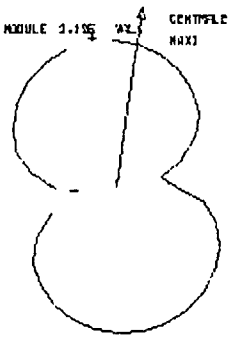
MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 100°
MAXI 0.30 ANG ROT (MINIMUM) 100°

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 0°
MAXI 0.31 ANG ROT (MINIMUM) 0°

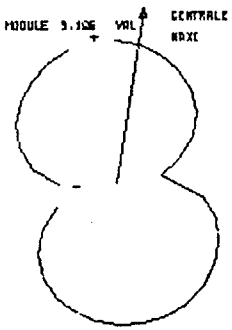


YZ

MODULE 3.155 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 190°
MAXI 0.108 ANG ROT (MAXIMUM) 80°



MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 342°
MAXI 0.157 ANG ROT (MAXIMUM) 52°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 15

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/29 | 18<br>21 | A<br>B | 17<br>20 | A<br>B | 19 | A-B |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth | | |
|---|---|---|---|---|---|
| | Ex | 10 | 9 | = | 9°E |
| | Ey | 310 | 279 | = | 81°W |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 91°W | 10 | 359 = 1W | YX | XY |
| STRIKE from Hz | 82°W | | | | |

## COMMENTS

### FIELD

- opening in the forest
- snow - wind
- water dull hole nearby (100m)

### PROCESSING

Fair except between ·3 and 3 s

HF: ρE#ρF
LF: ρE>ρF

MISSION Z404-25-11

CLIENT : UNION

DATE : 17/11/82

RHO INV 1 (OPT= 1) A15

1.0

0.5 COHERENCE

0.0

0.01

1000.00

OHM.M

1000.00

1000.00

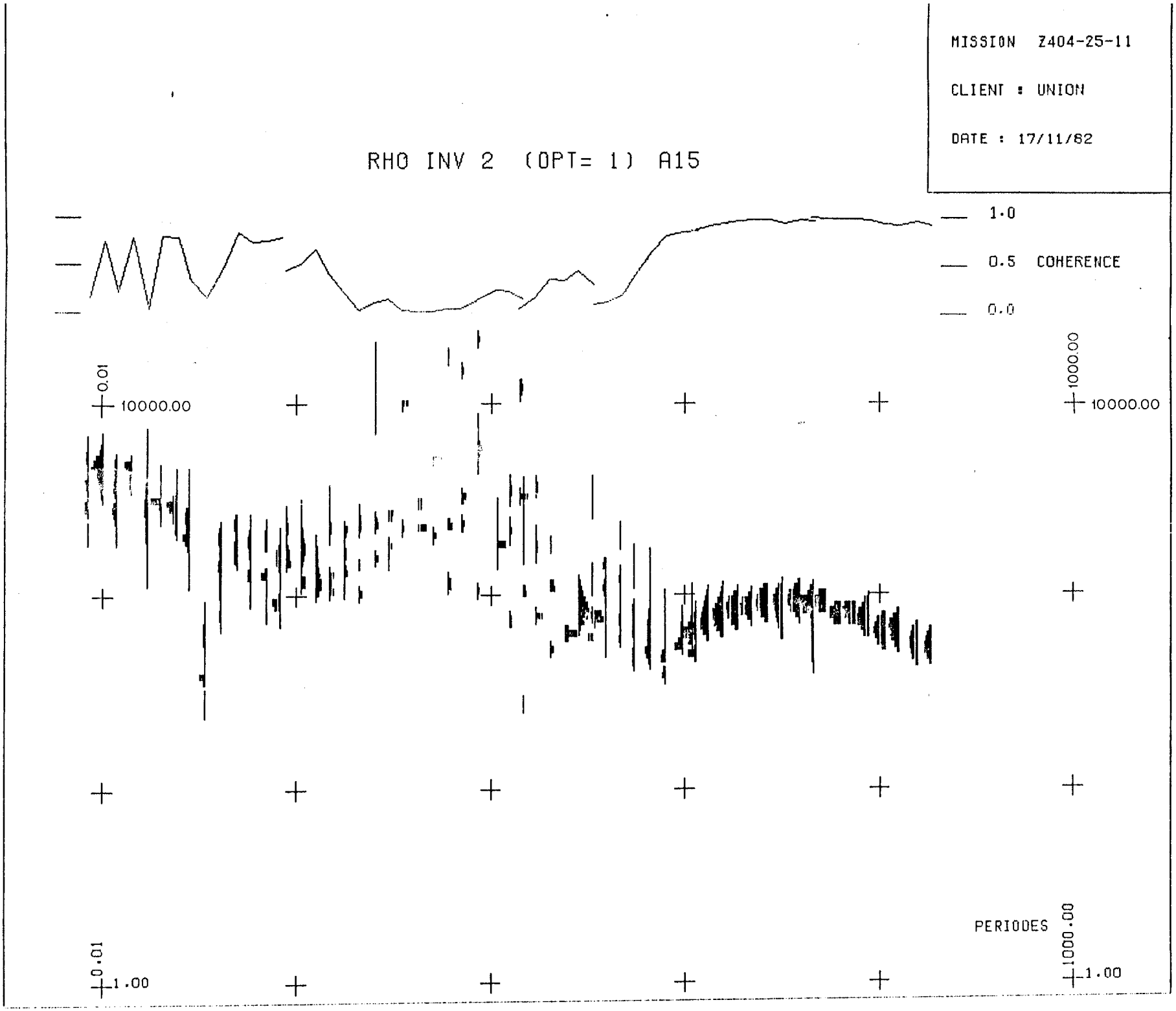
PERIODES

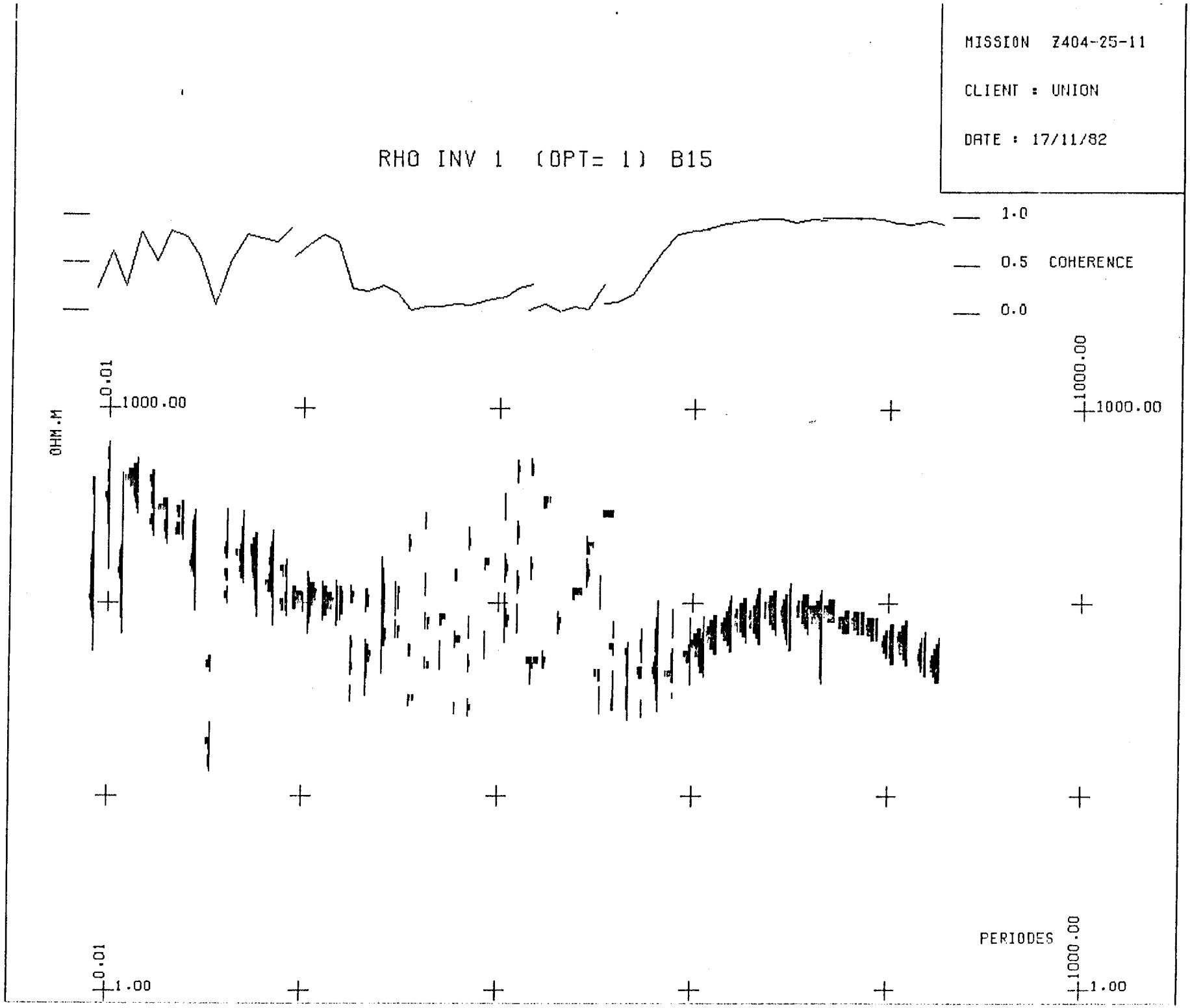
0.01

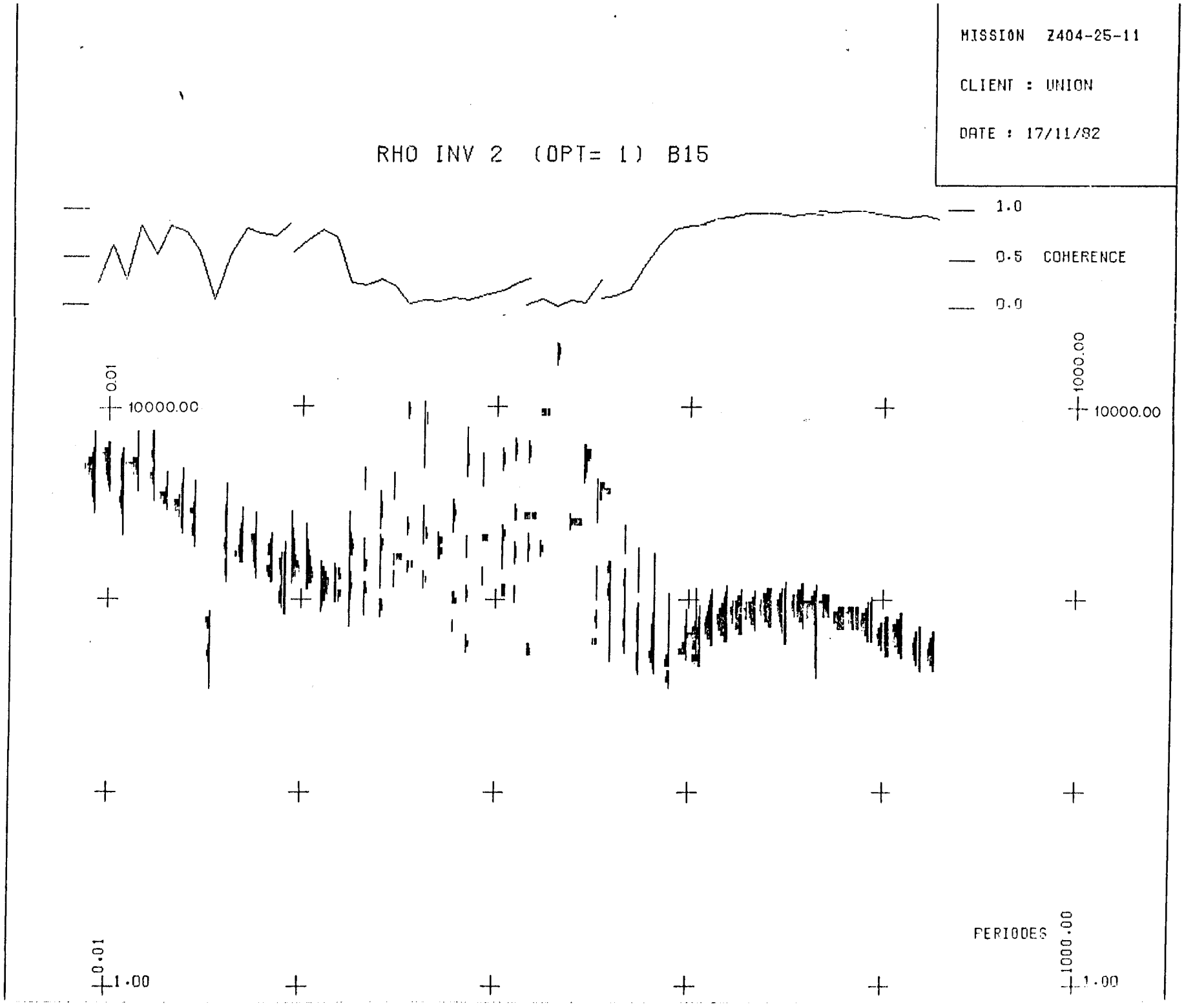
1.00

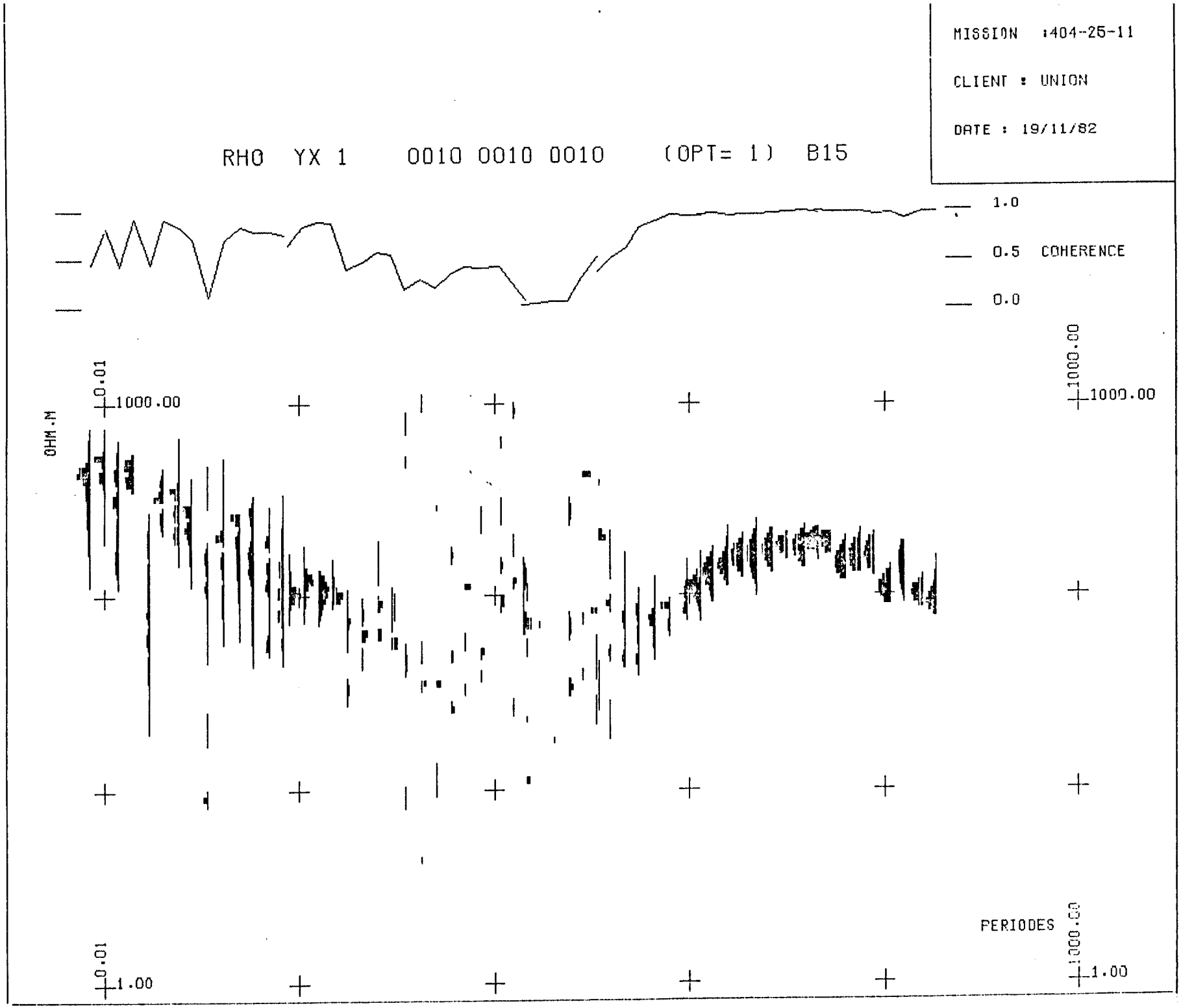
1000.00

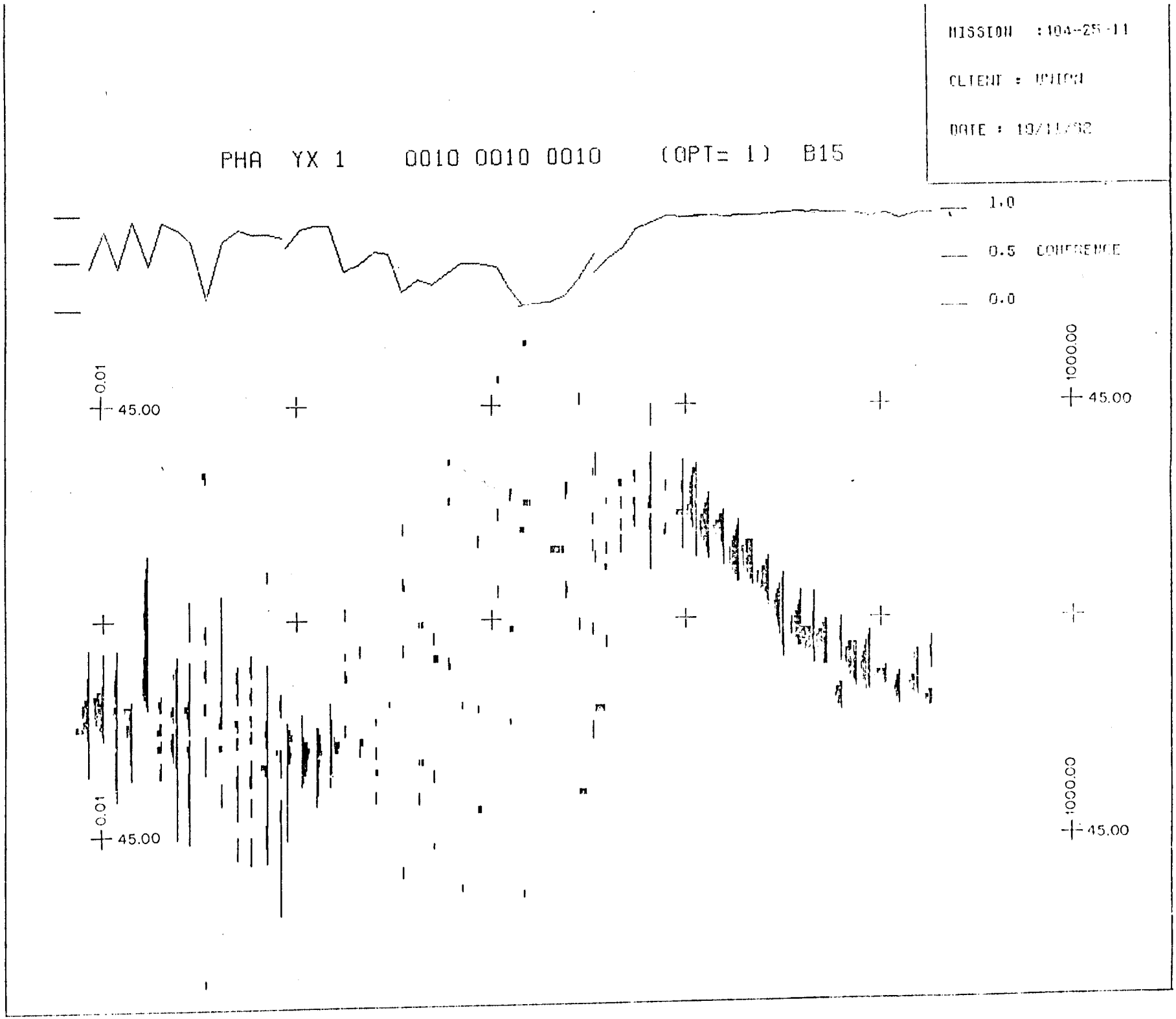
1.00

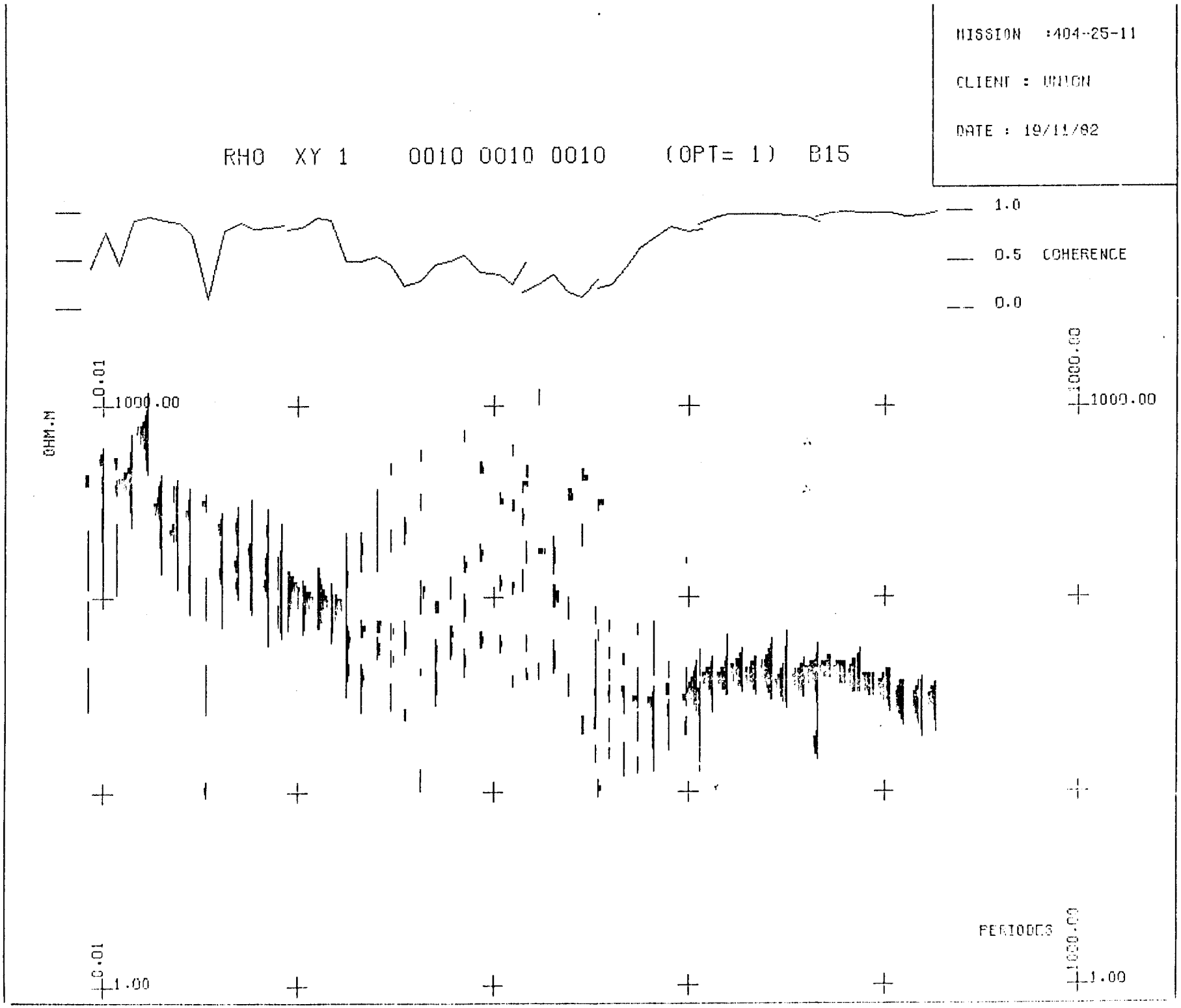

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO INV 2 (OPT= 1) A15
1.0
0.5 COHERENCE
0.0
0.01
10000.00
1000.00
10000.00
PERIODES
0.01
1.00
1000.00
1.00

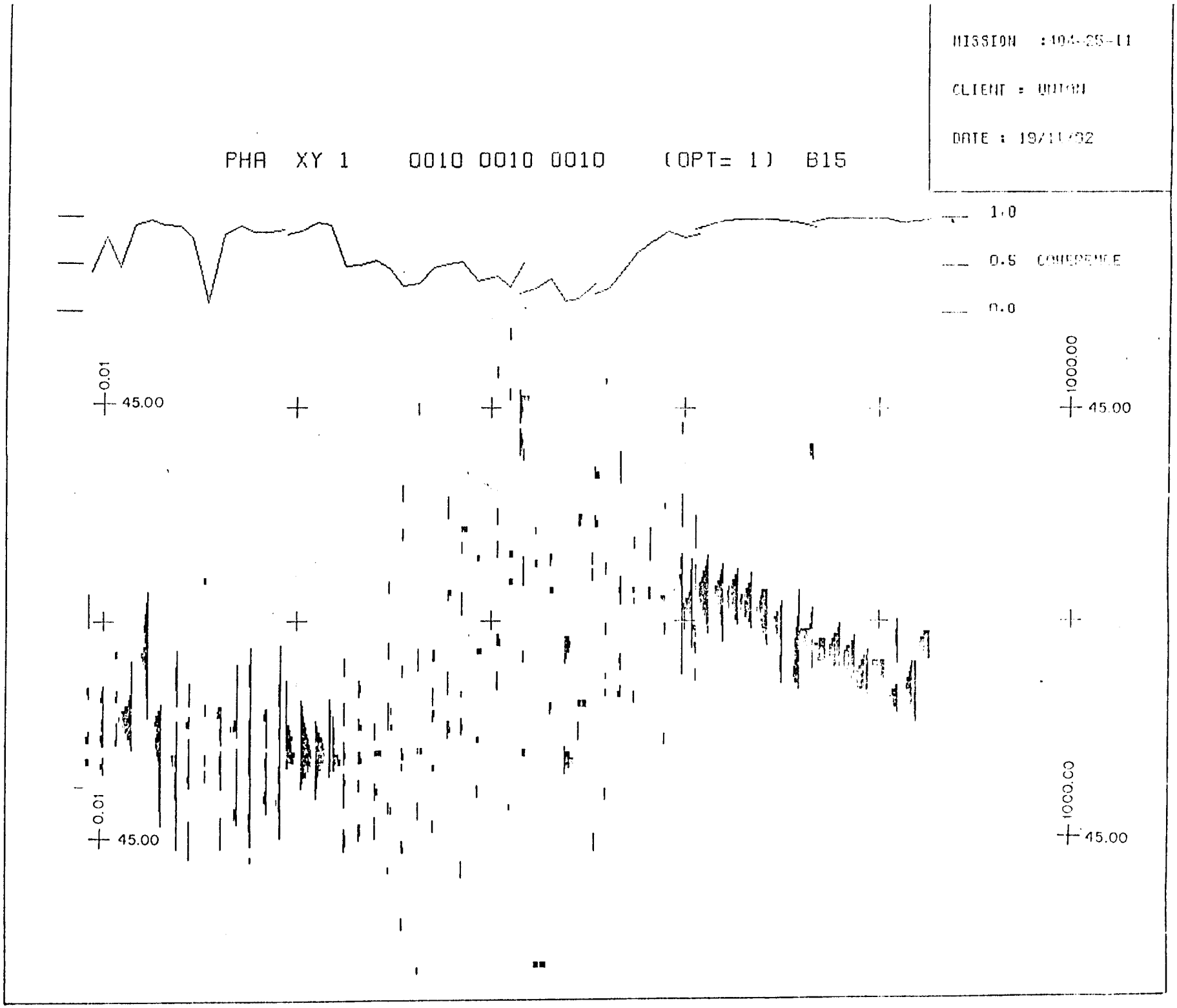

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO INV 1 (OPT= 1) B15
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
OHM.M
PERIODES
0.01
1.00
1000.00
1.00

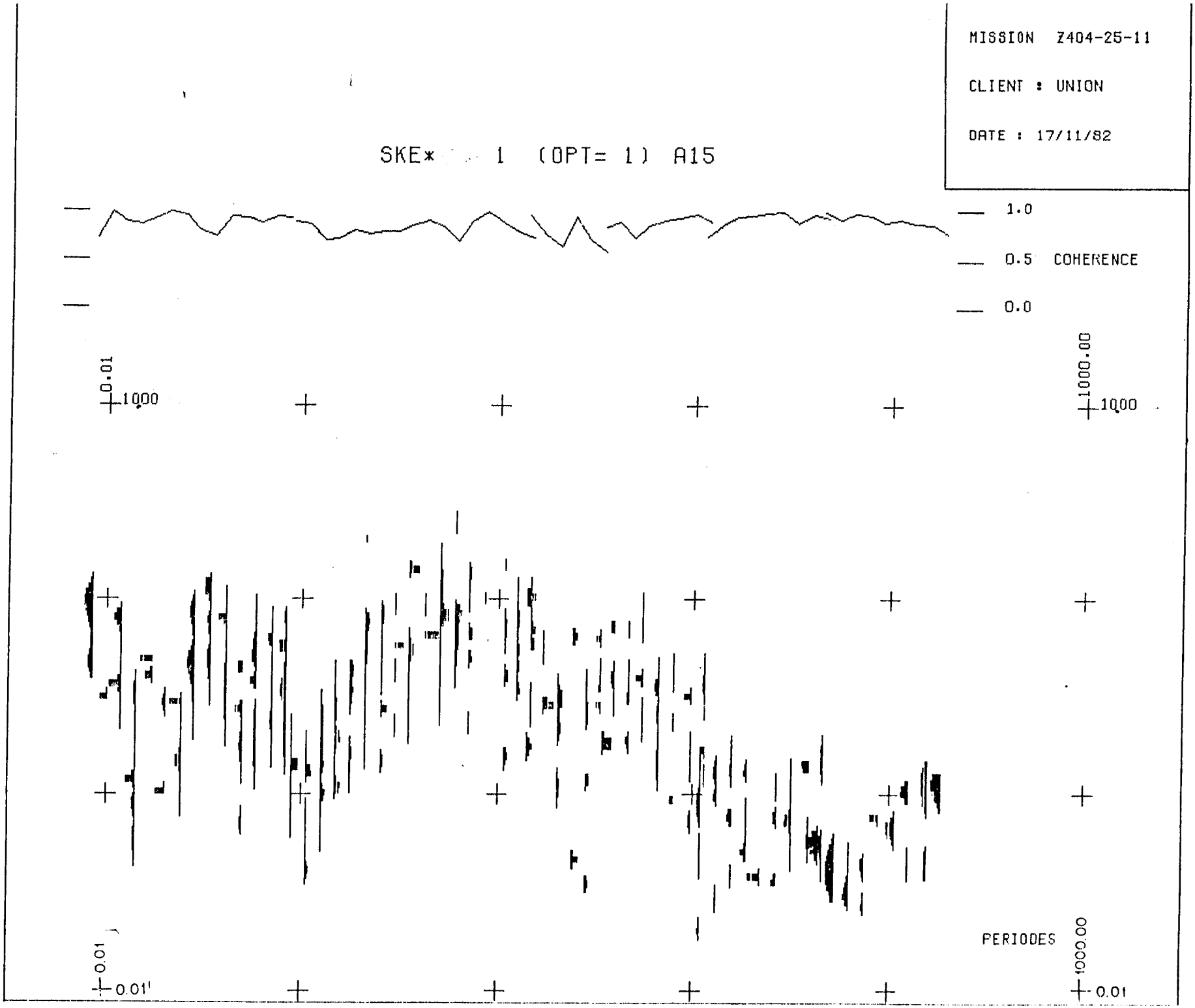

MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
RHO INV 2 (OPT= 1) B15
1.0
0.5 COHERENCE
0.0
0.01
10000.00
1000.00
10000.00
PERIODES
0.01
1.00
1000.00
1.00

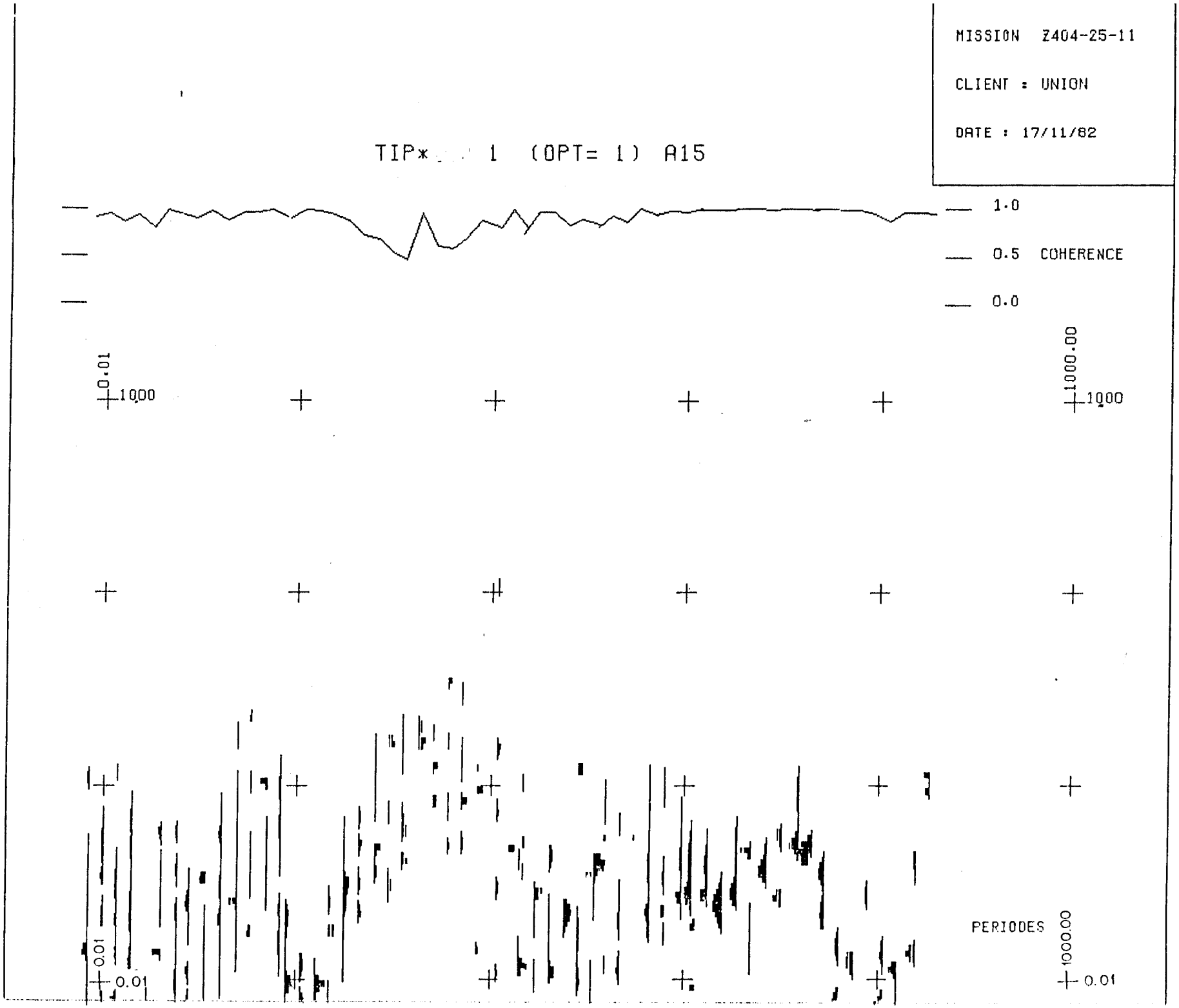

MISSION :404-25-11
CLIENT : UNION
DATE : 19/11/82
RHO YX 1 0010 0010 0010 (OPT= 1) B15
1.0
0.5 COHERENCE
0.0
0.01
1000.00
OHM.M
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00

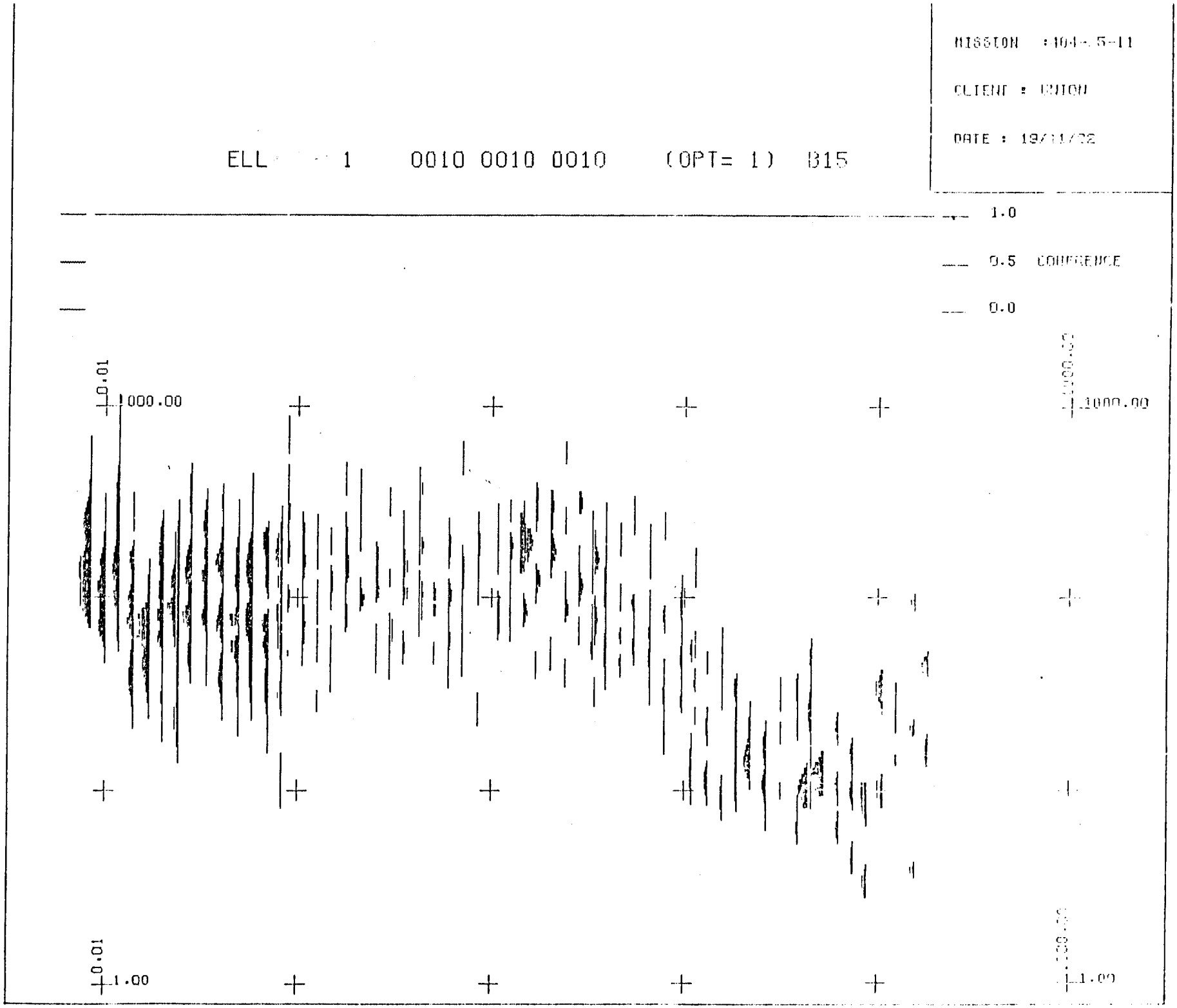

MISSION : 104-25-11
CLIENT : UNION
DATE : 19/11/82
PHA YX 1 0010 0010 0010 (OPT= 1) B15
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 19/11/82
RHO XY 1 0010 0010 0010 (OPT= 1) B15
1.0
0.5 COHERENCE
0.0
OHM.M
0.01
1000.00
1000.00
1000.00
PERIODES
0.01
1.00
1000.00
1.00


MISSION :494-25-11
CLIENT : UNION
DATE : 19/11/92
PHA XY 1 0010 0010 0010 (OPT= 1) B15
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
SKE* 1 (OPT= 1) A15
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
10.00
PERIODES
0.01
0.01
1000.00
0.01


MISSION Z404-25-11
CLIENT : UNION
DATE : 17/11/82
TIP* 1 (OPT= 1) A15
1.0
0.5 COHERENCE
0.0
0.01
1000
1000.00
1000
PERIODES
1000.00
0.01
0.01
0.01

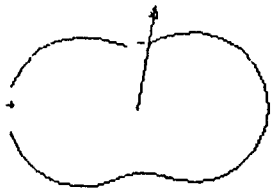

MISSION :104-5-11
CLIENT : UNION
DATE : 19/11/92
ELL 1 0010 0010 0010 (OPT= 1) B15
1.0
0.5 COHERENCE
0.0
0.01
000.00
1000.00
0.01
1.00
1.00

STATION D15
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 10DR
SKEW = 0.034
TIPPER = 0.174
COMBINAISON 1

MISSION : 2404-85-11
CLIENT : UNION
DATE : 17/11/92

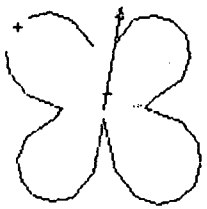
XY

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 352°
MAXI 124.2 ANG ROT (MINIMUM) 10°



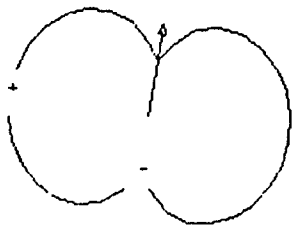
XX

MODULE 3.652 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 358°
MAXI 10.35 ANG ROT (MINIMUM) 10°



YZ

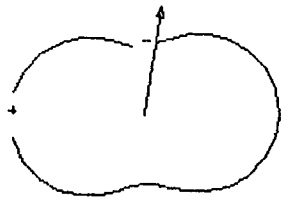
MODULE 3.156 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 278°
MAXI 0.173 ANG ROT (MAXIMUM) 80°



SKEW = 0.030
TIPPER = 0.175
COMBINAISON 2

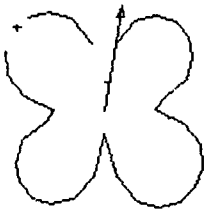
XY

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 352°
MAXI 148.0 ANG ROT (MINIMUM) 10°



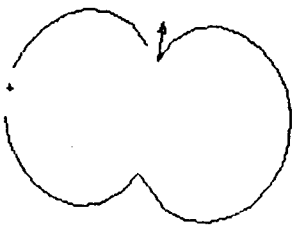
XX

MODULE 3.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 358°
MAXI 11.32 ANG ROT (MINIMUM) 10°



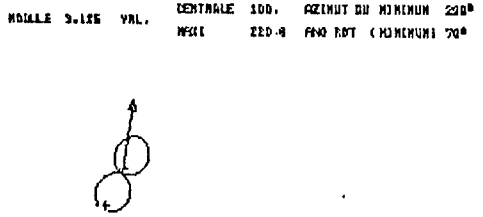
YZ

MODULE 3.156 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 278°
MAXI 0.174 ANG ROT (MAXIMUM) 80°

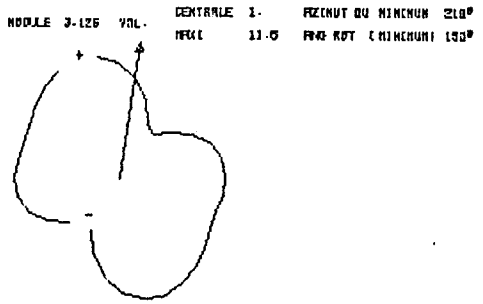


STATION H15
DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 10cm
SKEW = 0.061
TIPPER = 0.090
COMBINAISON 1

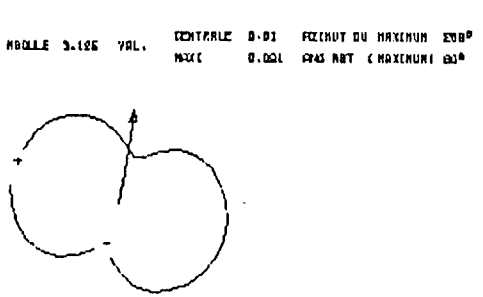
XY




XX



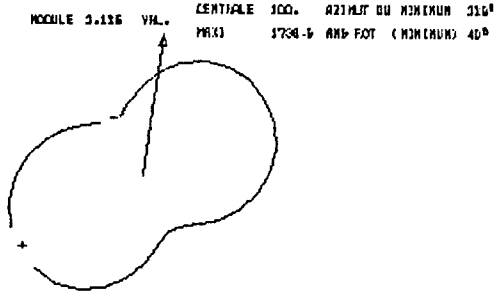

YZ



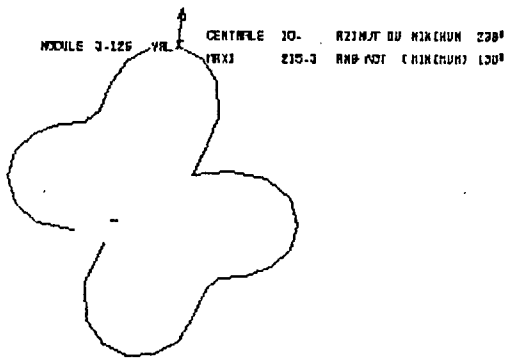

MISSION : Z404-[illegible]-11
CLIENT : UNIBM
DATE : 17/11/81

SKEW = 0.071
TIPPER = 0.080
COMBINAISON 2

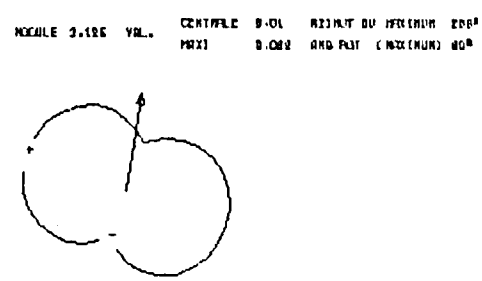
XY




XX



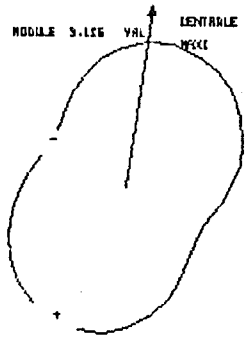

YZ



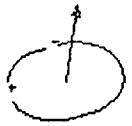
DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 10GR
SKEW = 0.171
TIPPER = 0.092
COMBINAISON 1

SKEW = 0.025
TIPPER = 0.090
COMBINAISON 2

XY

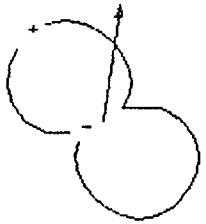


XY

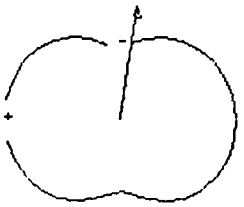


XX

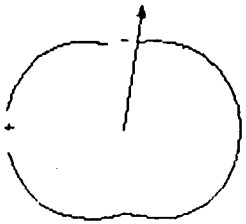
XX



YZ



YZ



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 16

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/20 | 48<br>51 | A<br>B | 47<br>50 | A<br>B | 49 | A-B |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 140 | 126 = 126°E |
| | Ey | 40 | 36 = 36°E |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 24°W | 60 | 66 = 66E | YX | XY |
| STRIKE from Hz | 44°W | | | | |

## COMMENTS

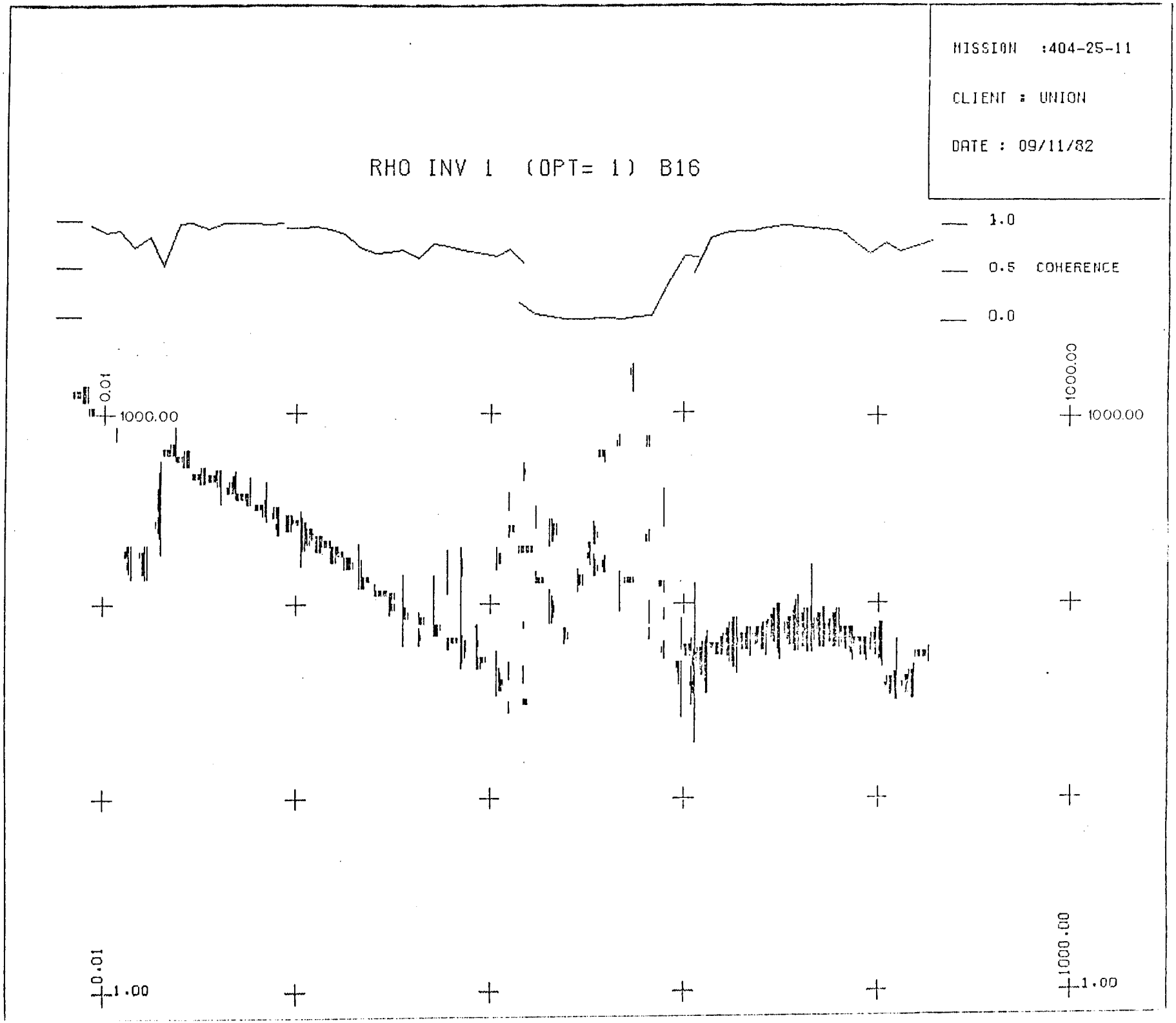
### FIELD

clouds - light rain
Fair signal
approaching thunderstorm

### PROCESSING

Fair

LF: $\rho E > \rho H$

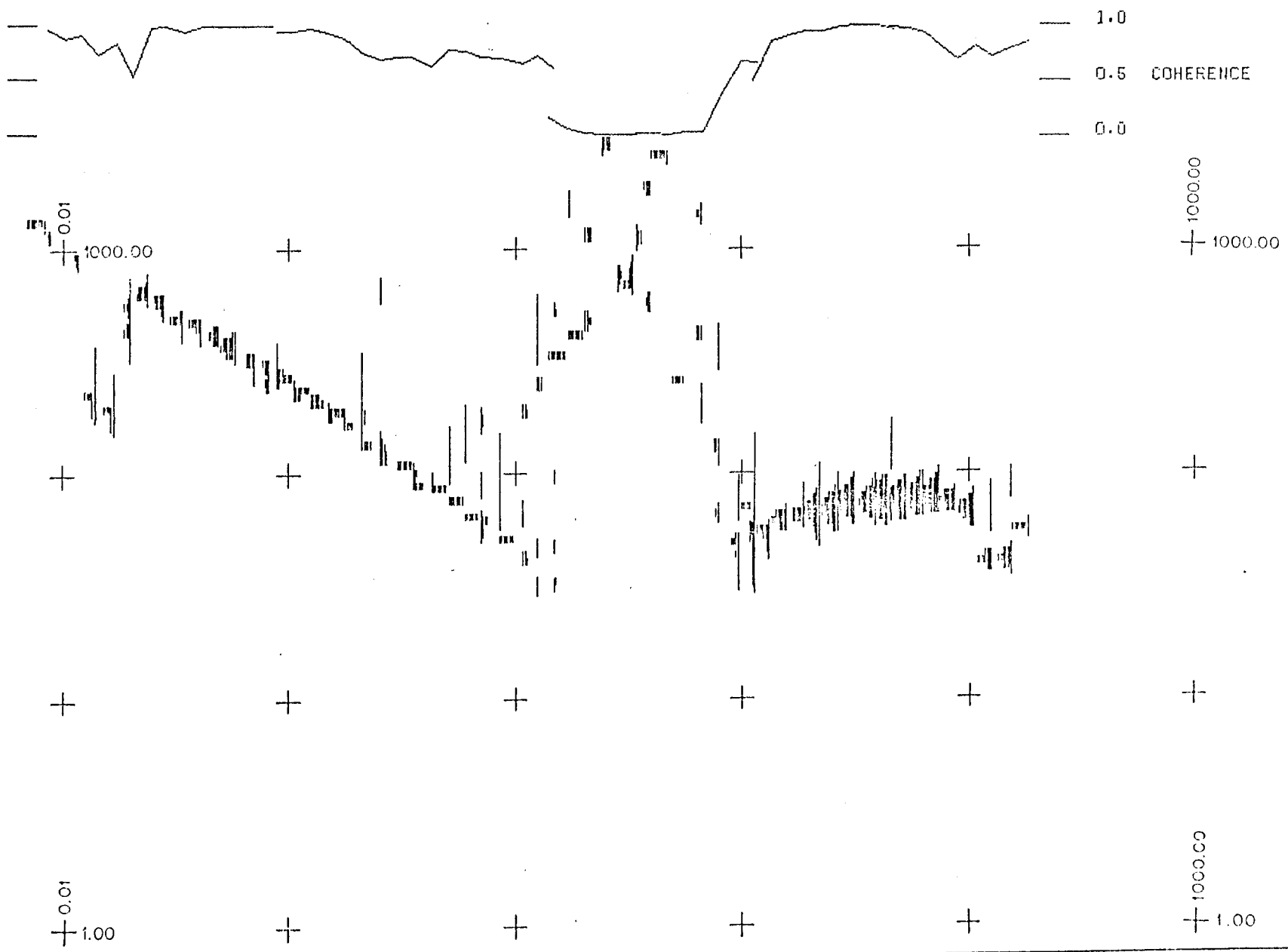

MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
RHO INV 1 (OPT= 1) B16
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

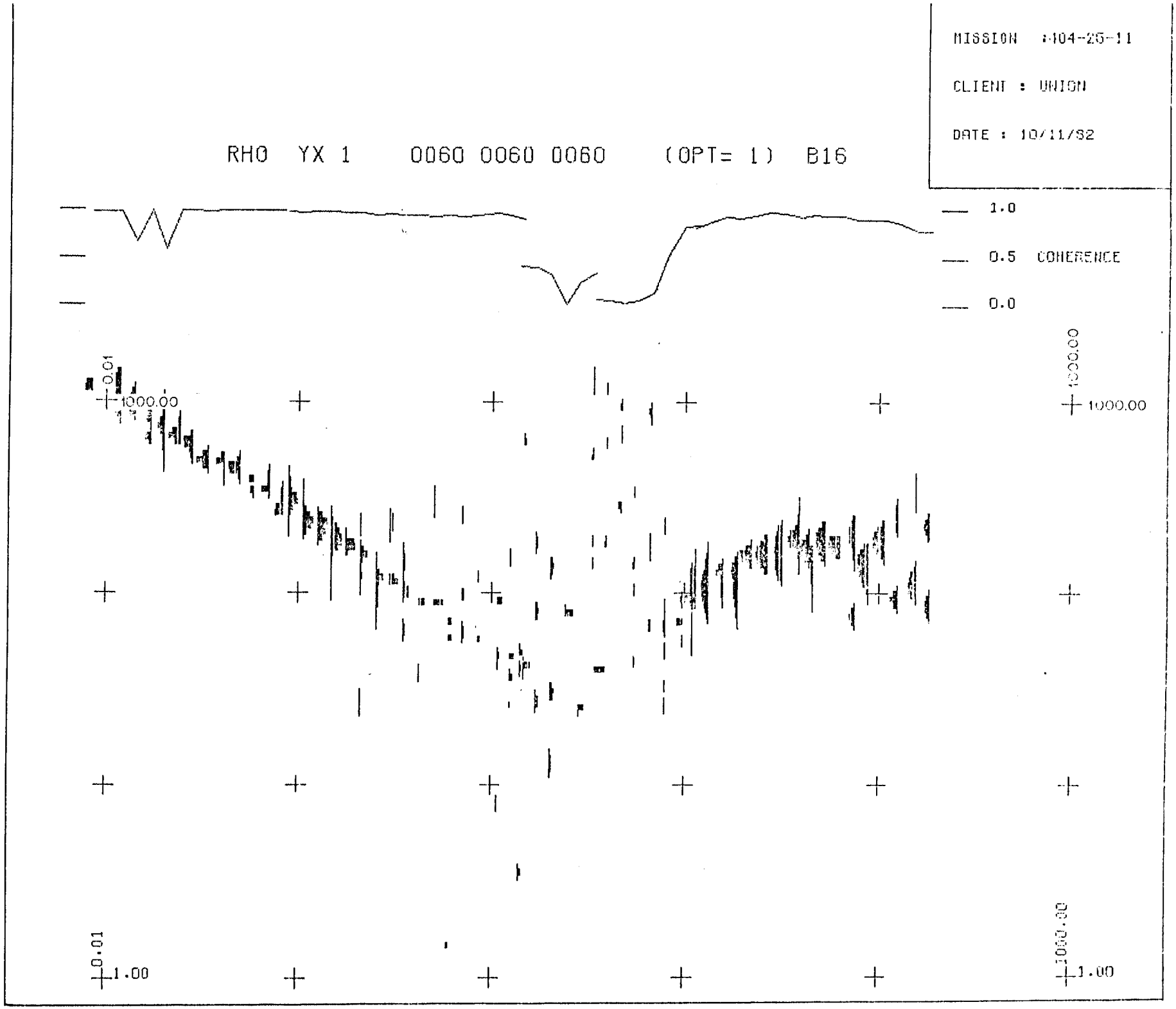
MISSION :404-25-11

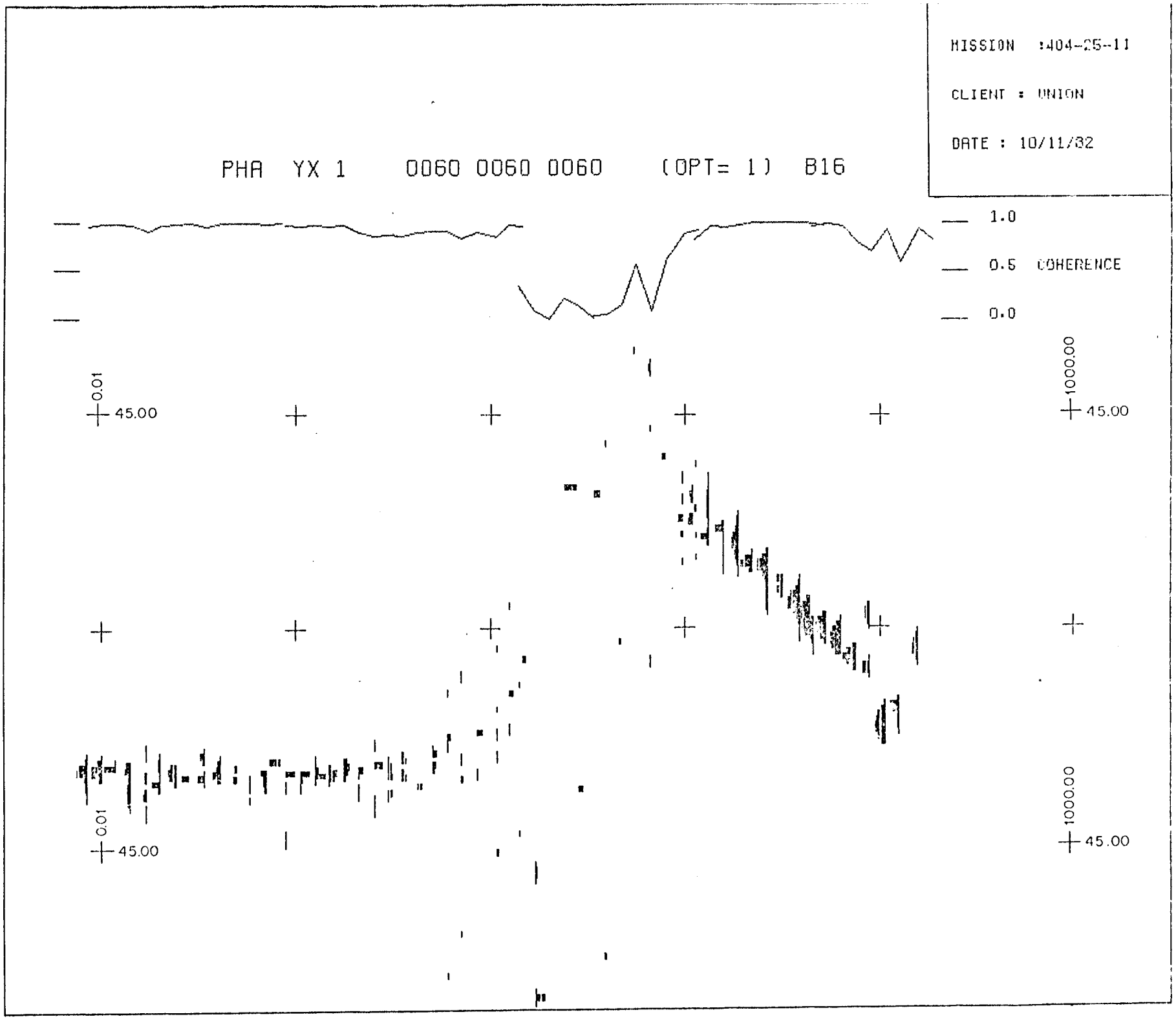
CLIENT : UNION

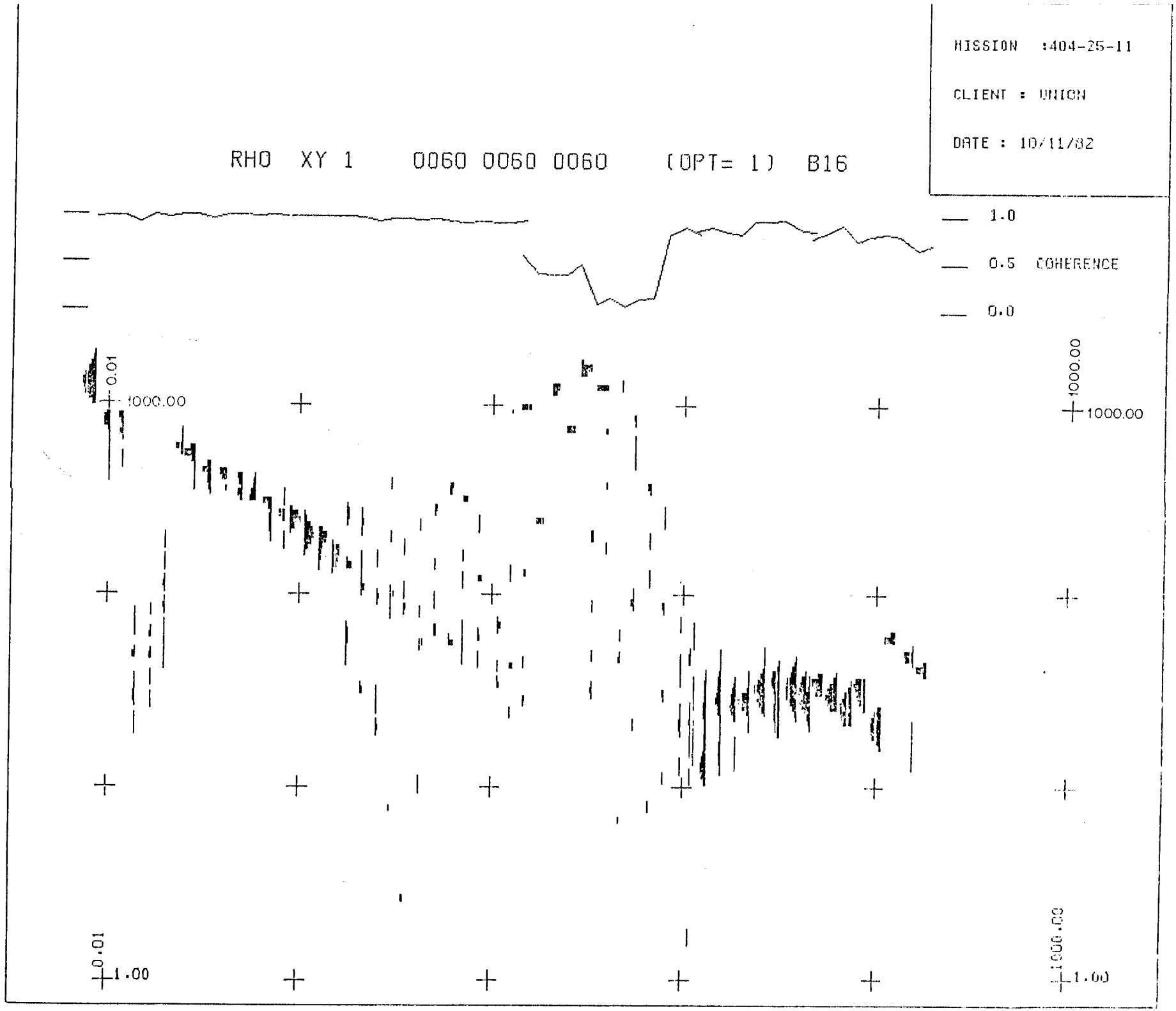
DATE : 09/11/82

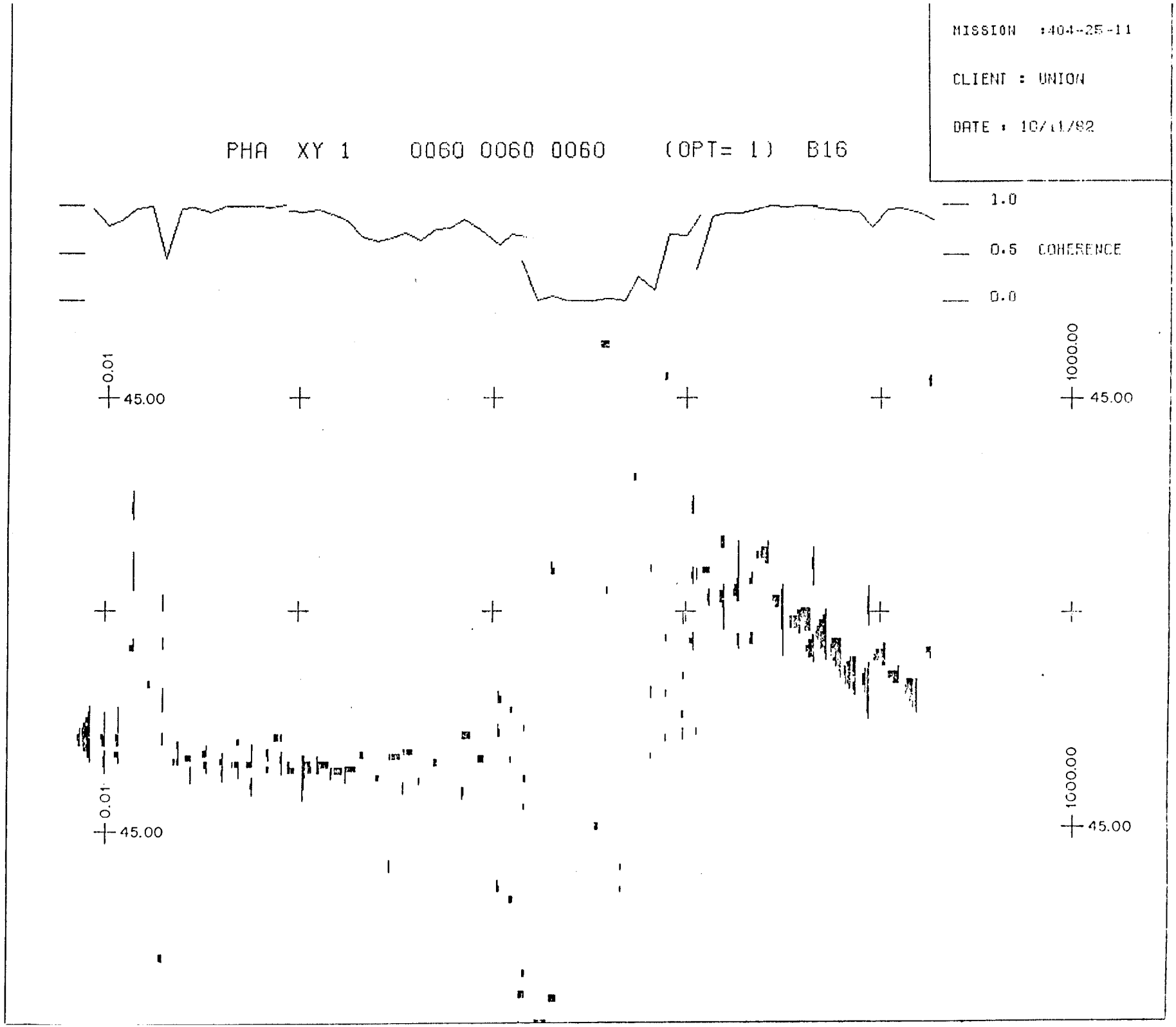
RHO INV 2 (OPT= 1) B16

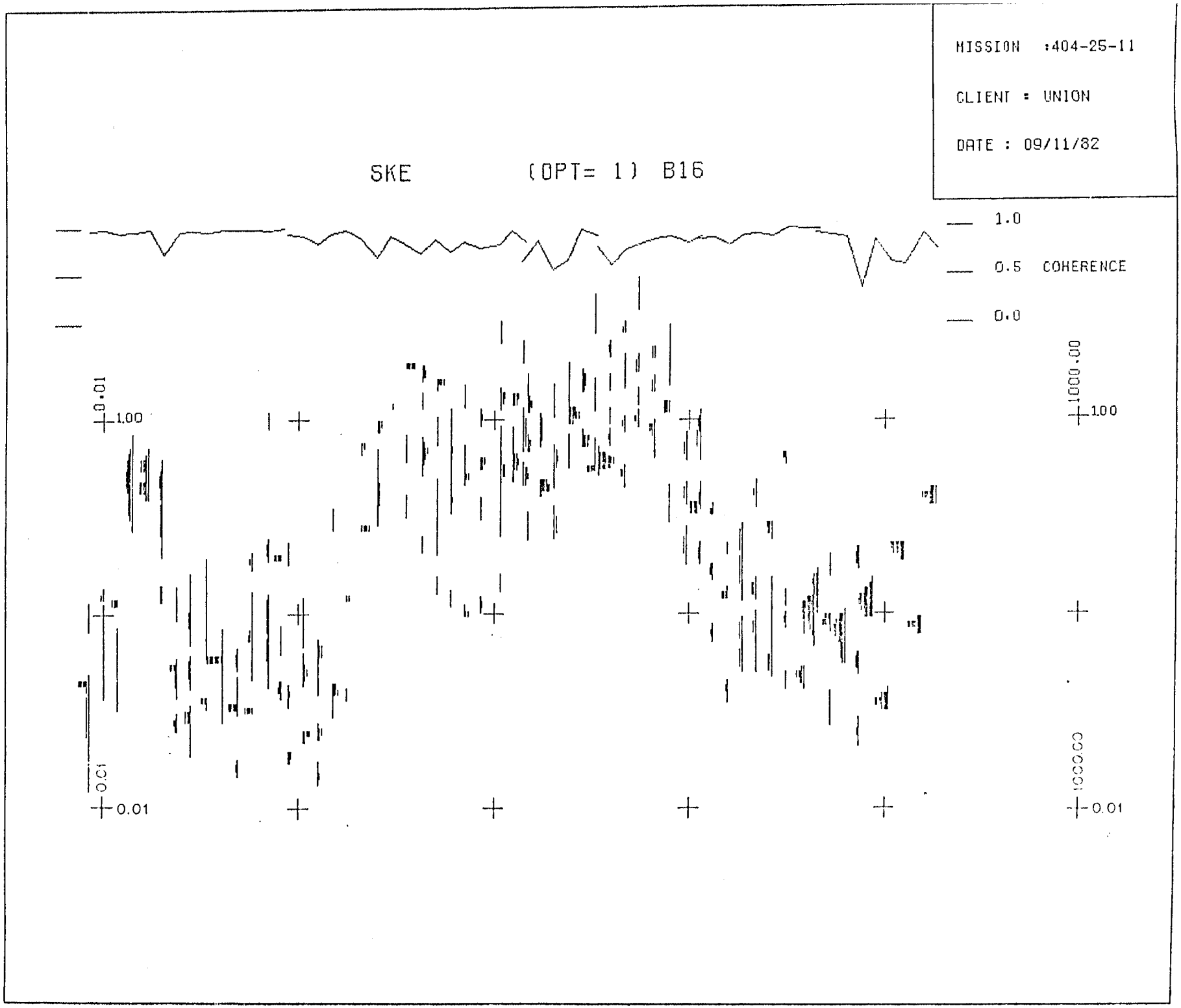


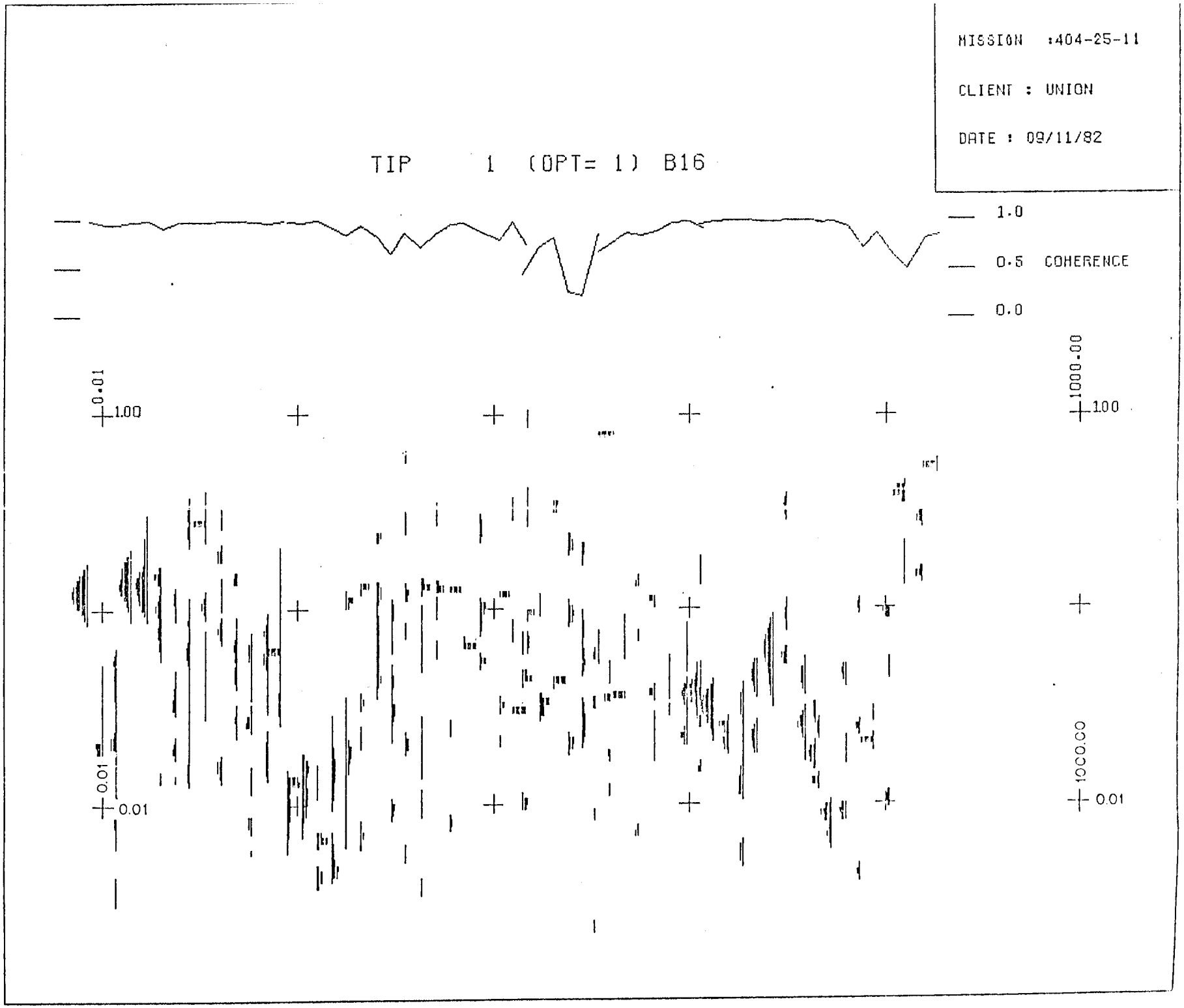

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
RHO YX 1 0060 0060 0060 (OPT= 1) B16
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1060.30
1.00

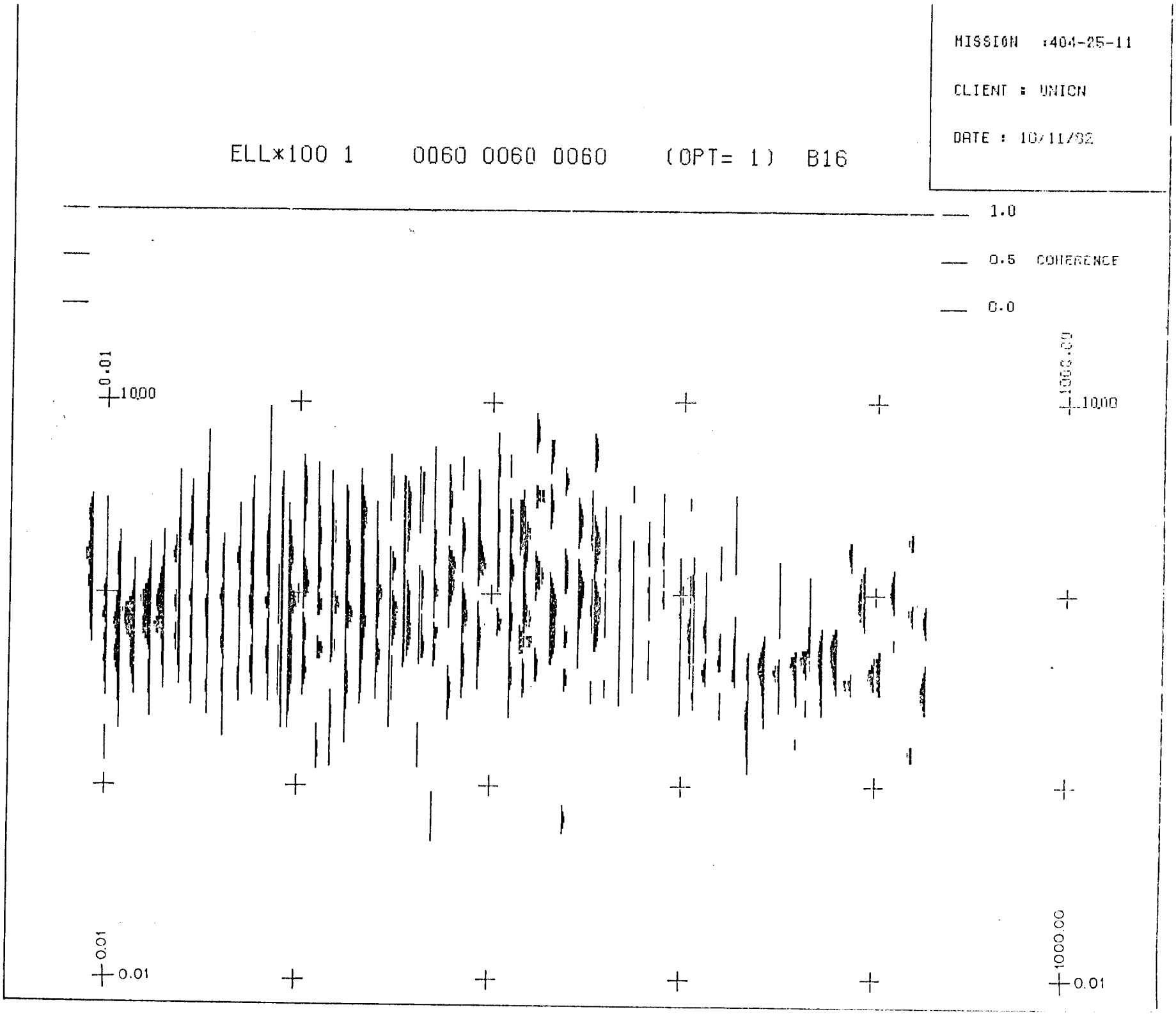

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
PHA YX 1 0060 0060 0060 (OPT= 1) B16
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
RHO XY 1 0060 0060 0060 (OPT= 1) B16
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/92
PHA XY 1 0060 0060 0060 (OPT= 1) B16
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT = UNION
DATE : 09/11/82
SKE (OPT= 1) B16
1.0
0.5 COHERENCE
0.0
0.01
1.00
0.01
1000.00
1.00
0.01
0.01


MISSION :404-25-11
CLIENT : UNION
DATE : 09/11/82
TIP 1 (OPT= 1) B16
1.0
0.5 COHERENCE
0.0
0.01
1.00
0.01
0.01
1000.00
1.00
1000.00
0.01

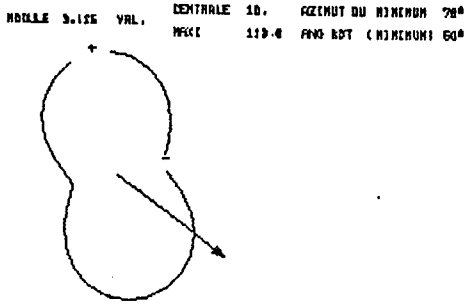

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/92
ELL*100 1 0060 0060 0060 (OPT= 1) B16
1.0
0.5 COHERENCE
0.0
0.01
10.00
1000.00
10.00
0.01
0.01
1000.00
0.01

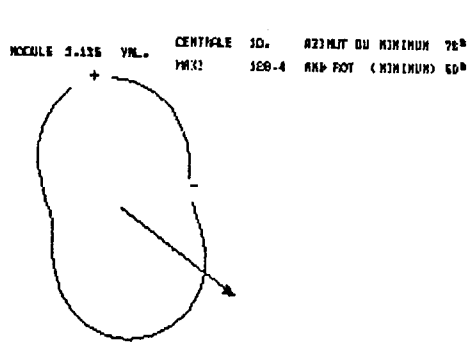
STATION B10
DOMAINE BF
DECOUPAGE EN 12
TMIN = 11.13
TMAX = 22.26
AZIMUT EX 140°
SKEW = 0.116
TIPPER = 0.155
COMBINAISON 1

MISSION : 404-83-11
CLIENT : UNION
DATE : 09/11/83

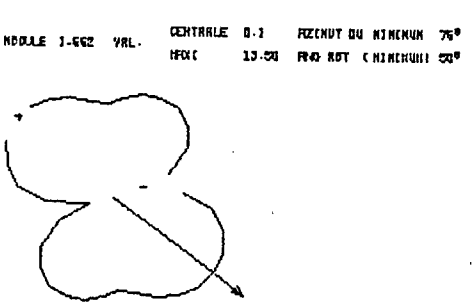
SKEW = 0.075
TIPPER = 0.156
COMBINAISON 2

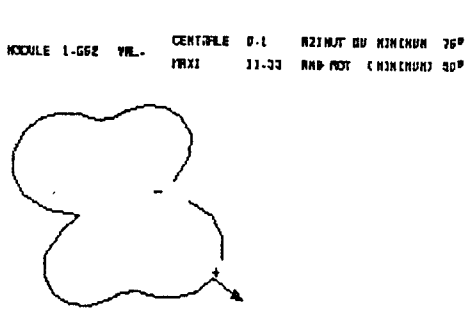
XY



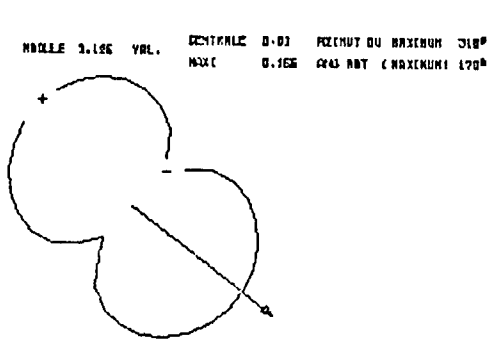



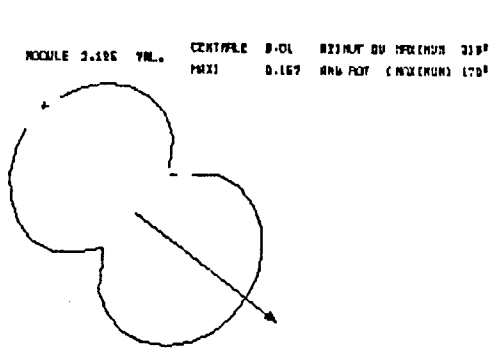

XX




YZ



STATION B16
DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 140gm
SKEW = 0.067
TIPPER = 0.068
COMBINAISON 1

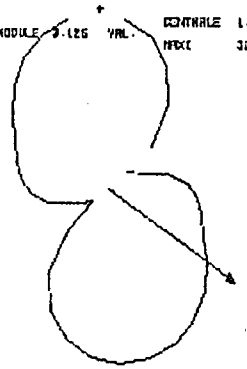
MISSION : 484-83-11
CLIENT : UNIBA
DATE : 02/11/83

XY

MODULE 3.13E VAL. CENTRALE 100. AZIMUT DU MINIMUM 6°
MAXI 385.0 ANG ROT (MINIMUM) 120°

XX

MODULE 3.12E VAL. CENTRALE 1. AZIMUT DU MINIMUM 66°
MAXI 33.1 ANG ROT (MINIMUM) 70°



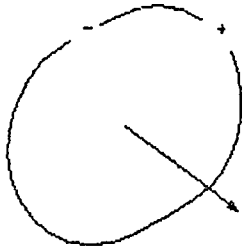
YZ

MODULE 3.12E VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 25°
MAXI 0.071 ANG ROT (MAXIMUM) 100°

SKEW = 0.039
TIPPER = 0.071
CONBINAISON 2

XY

MODULE 3.13E VAL. CENTRALE 100. AZIMUT DU MINIMUM 33E°
MAXI 1368.8 ANG ROT (MINIMUM) 150°



XX

MODULE 1.46E VAL. CENTRALE 10. AZIMUT DU MINIMUM 60°
MAXI 585.8 ANG ROT (MINIMUM) 80°

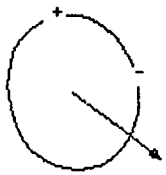
YZ

MODULE 3.13E VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 25°
MAXI 0.072 ANG ROT (MAXIMUM) 150°

DOMAINE HF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 140gr
SKEW = 0.017
TIPPER = 0.077
COMBINAISON 1

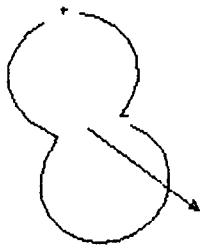
XY

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 78°
MAXI 464-3 ANG ROT (MINIMUM) 60°



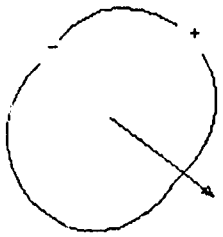
XX

MODULE 3.125 VAL. CENTRALE 1. AZIMUT DU MINIMUM 79°
MAXI 8.6 ANG ROT (MINIMUM) 50°



YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 40°
MAXI 0.094 ANG ROT (MAXIMUM) 80°

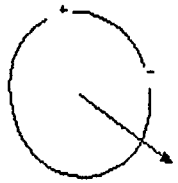


MISSION : 404-85-11
CLIENT : UNION
DATE : 08/11/82

SKEW = 0.015
TIPPER = 0.080
COMBINAISON 2

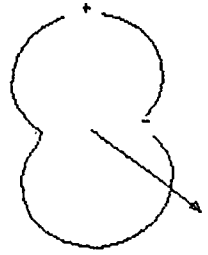
XY

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 78°
MAXI 582-3 ANG ROT (MINIMUM) 60°



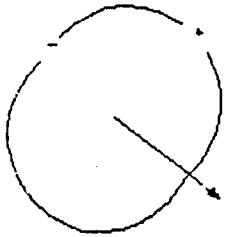
XX

MODULE 1.662 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 96°
MAXI 0.78 ANG ROT (MINIMUM) 40°



YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 40°
MAXI 0.027 ANG ROT (MAXIMUM) 40°



UNION GEOTHERMAL DIVISION
GLASS MOUNTAIN SURVEY

STATION: 17

| Date | FILE - INDEX | | | | | |
|---|---|---|---|---|---|---|
| 1982 | HF | | MF | | LF | |
| 10/20 | 53<br>56 | B<br>A | 52<br>55<br>58 | B<br>A | 54<br>57 | B<br>A |

| FIELD ARRAY | AZ. | Cent. ♀ | Sex. ♀ = Azimuth |
|---|---|---|---|
| | Ex | 300 | 270 = 90°W |
| | Ey | 200 | 180 = 180°E |

| | Azimuth | ROT. | Az. EX | $\rho_E$ | $\rho_H$ |
|---|---|---|---|---|---|
| STRIKE from Exy, Hxy | 10°W | 100 | 170 = 170E | XY | YX |
| STRIKE from Hz | 30°E | | | | |

COMMENTS

FIELD

clouds
fair signal on last records

PROCESSING

Fair
40° ≠ between HOR and VERT strikes

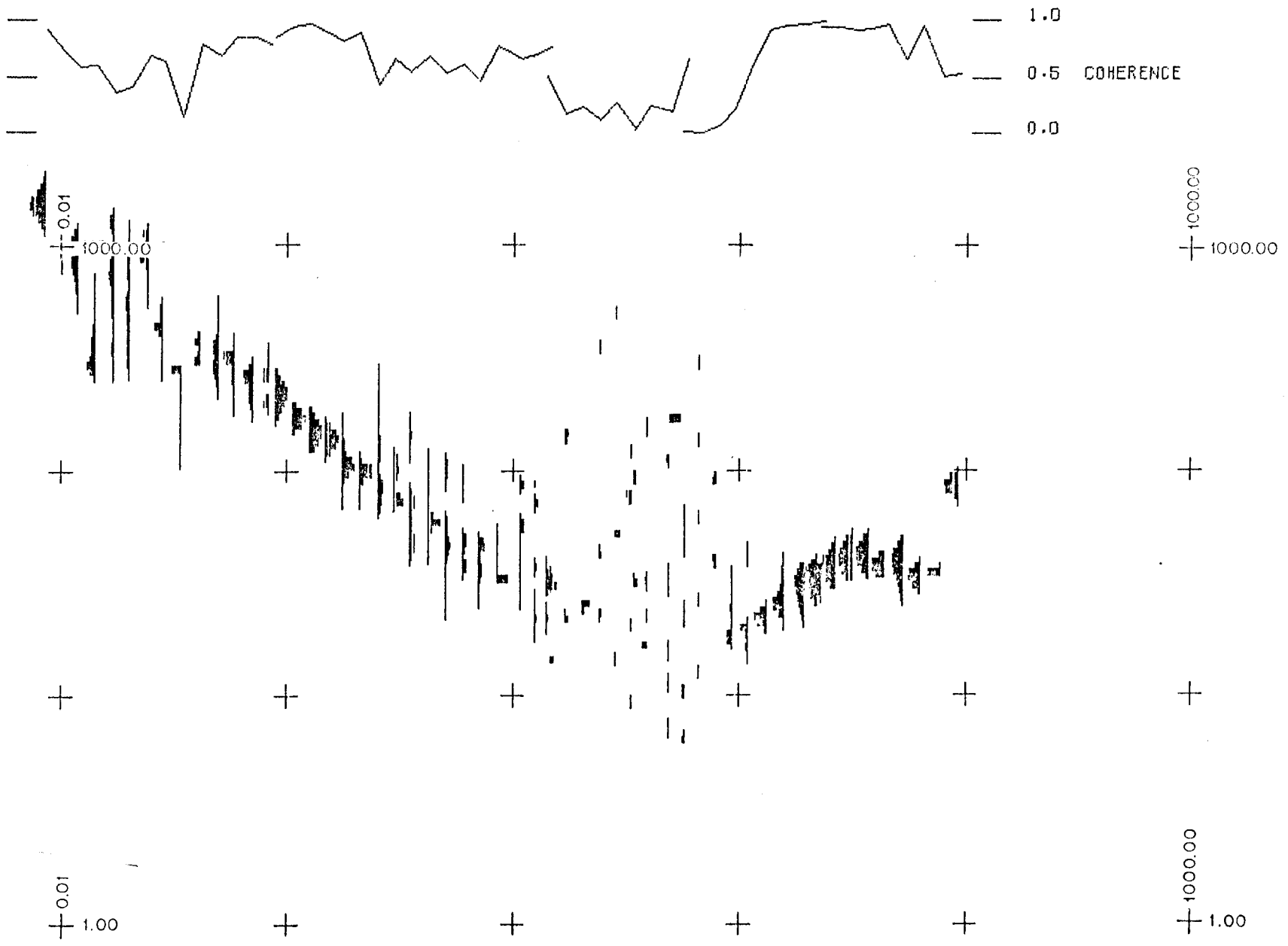
LF: $\rho E \neq < \rho H$ although E and H are not easily defined
(cf supra)

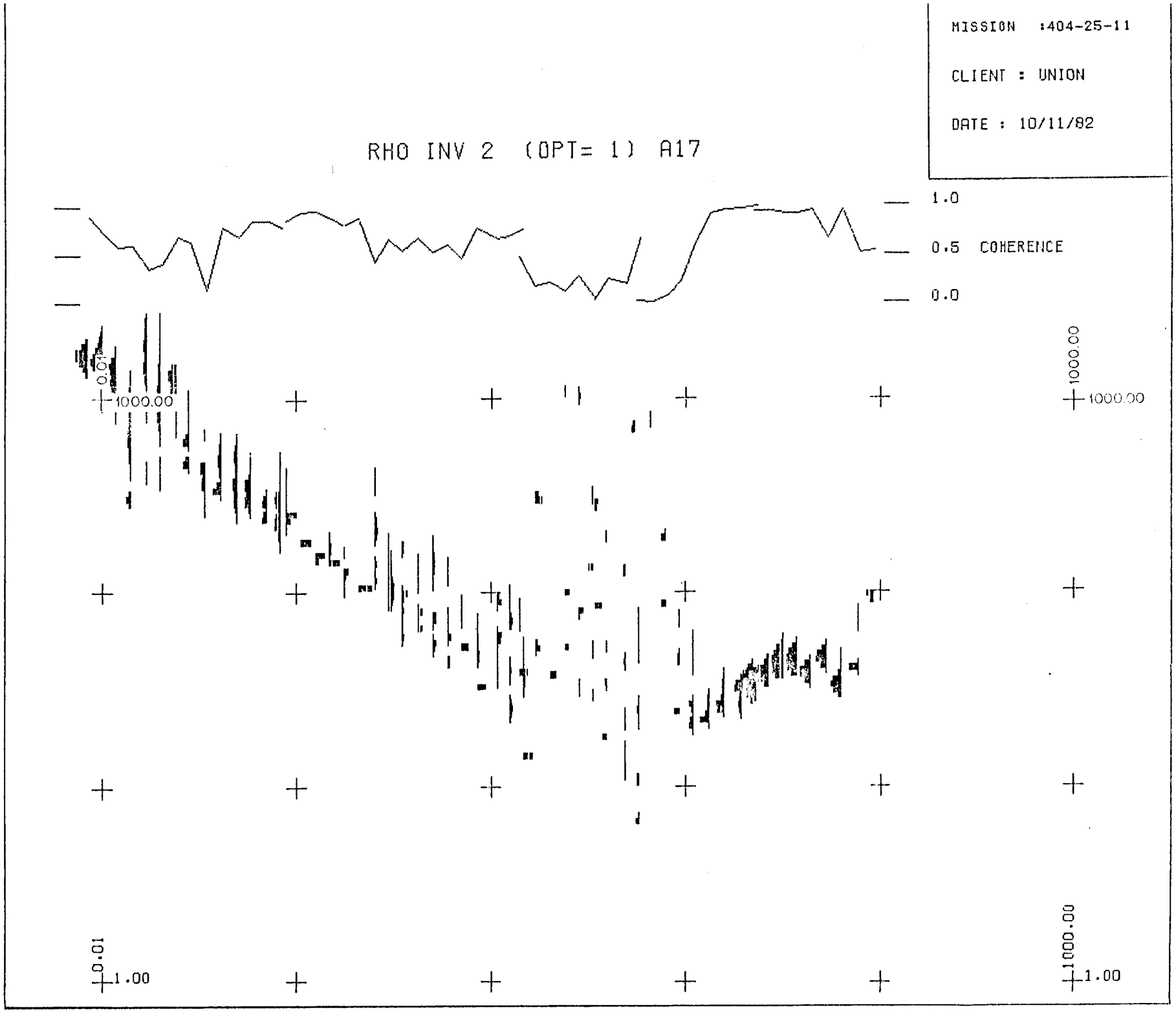
MISSION :404-25-11

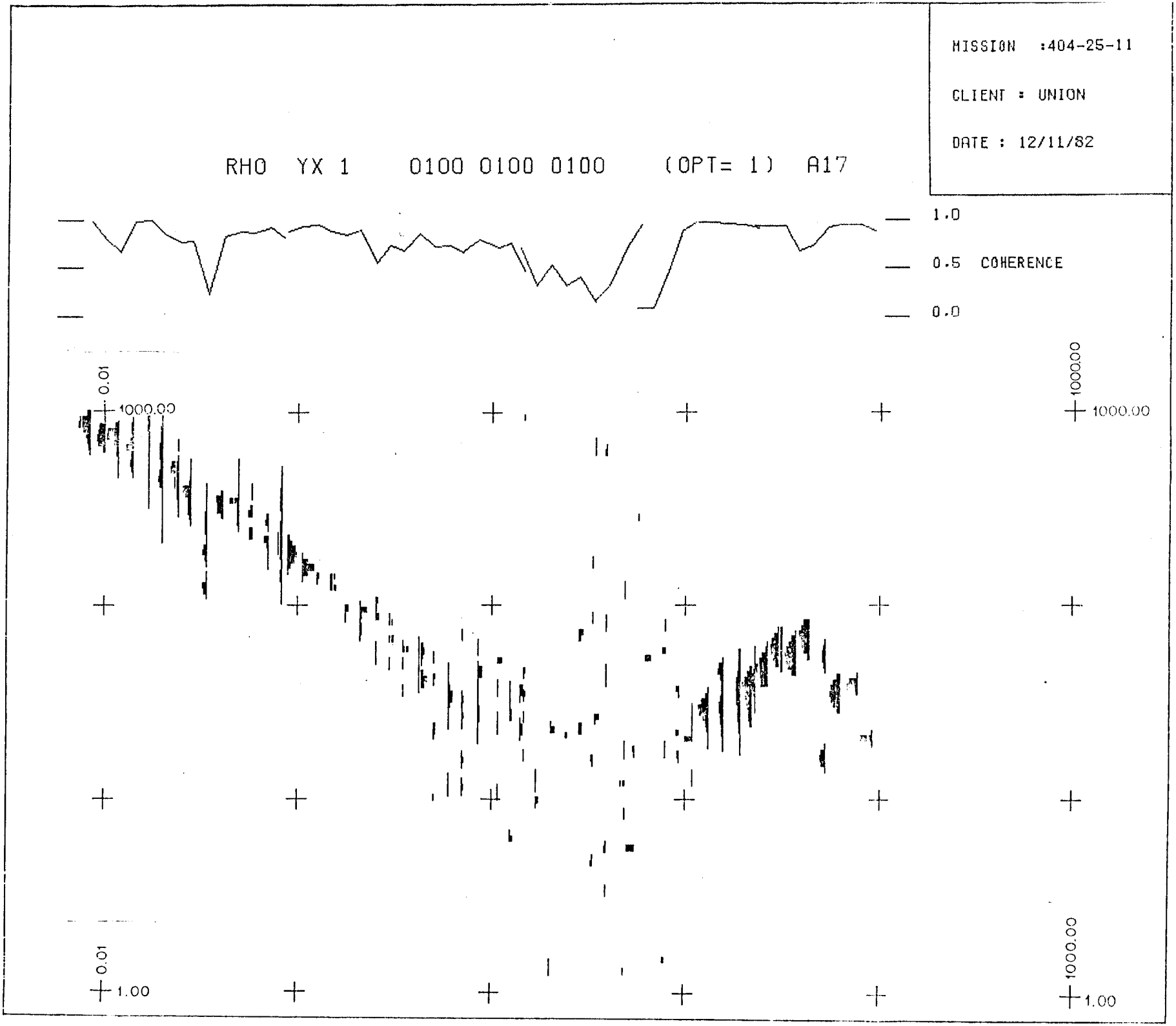
CLIENT : UNION

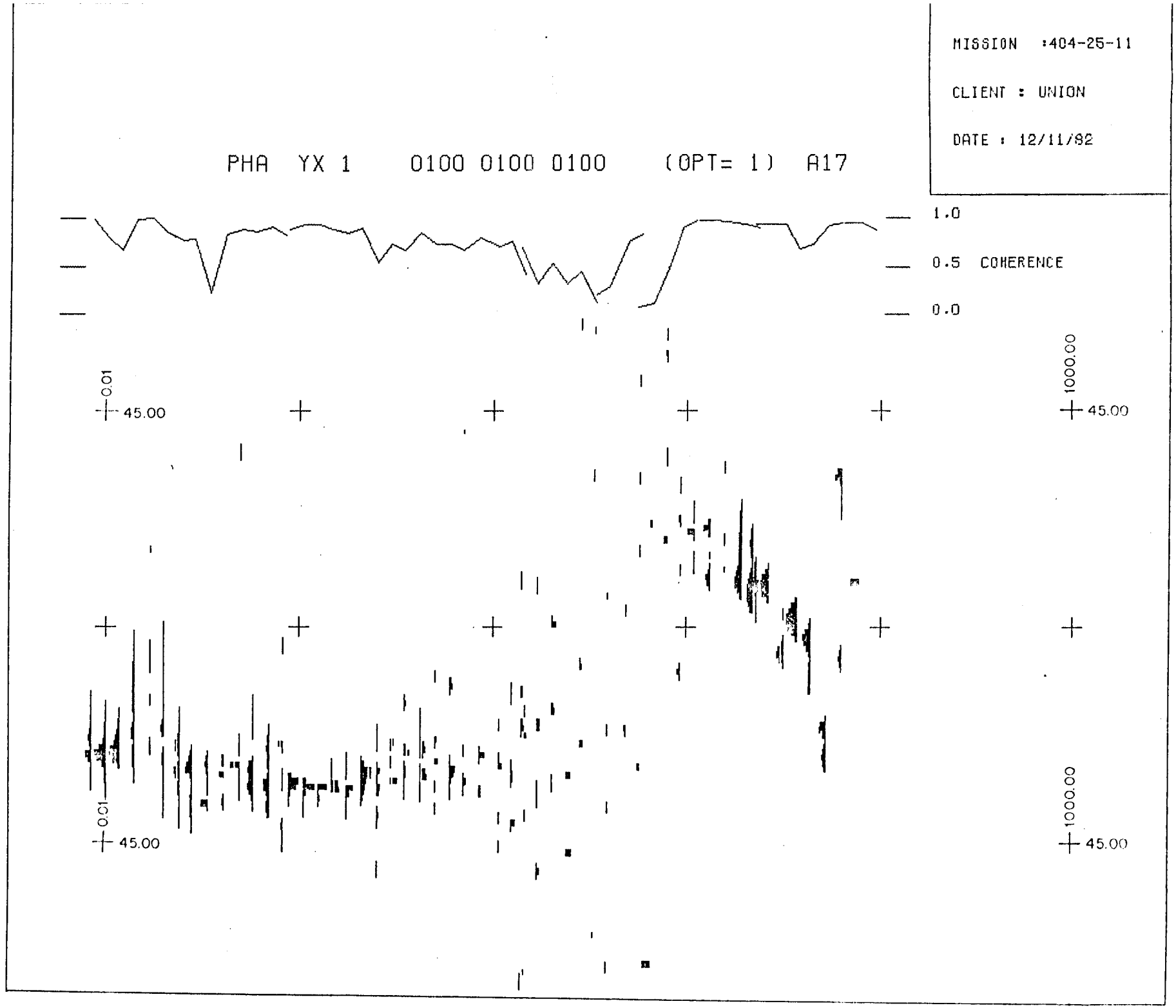
DATE : 10/11/82

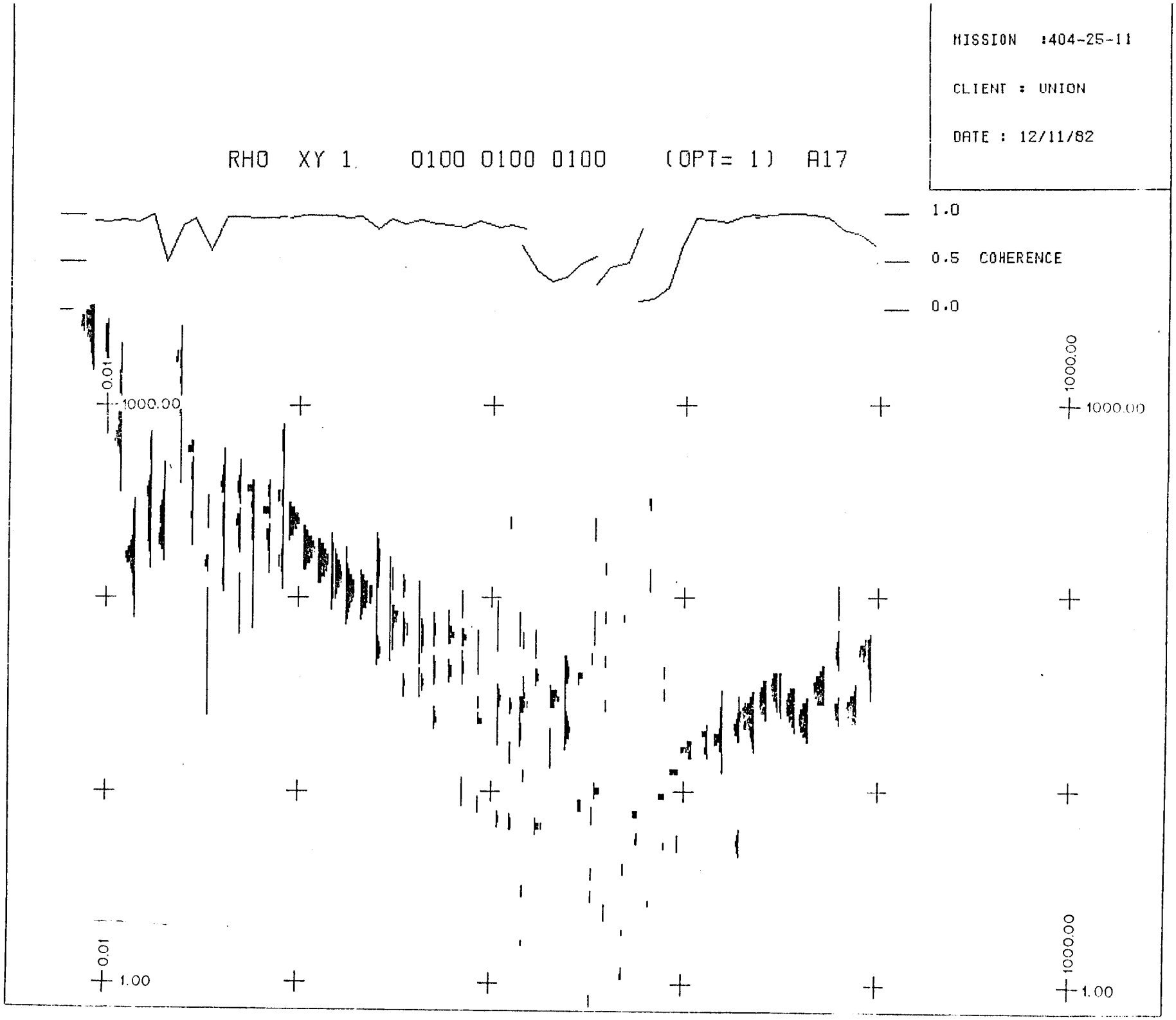
RHO INV 1 (OPT= 1) A17

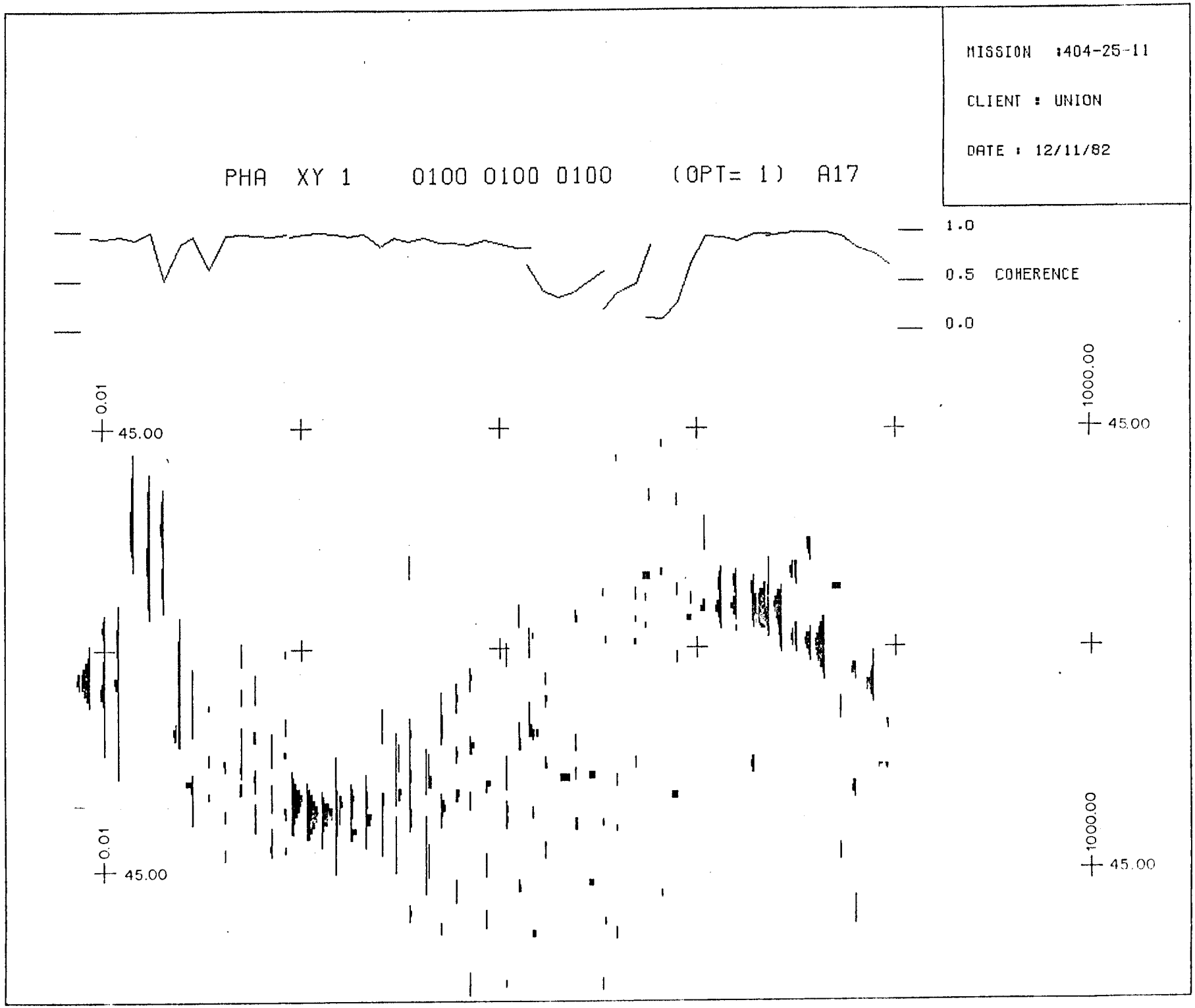


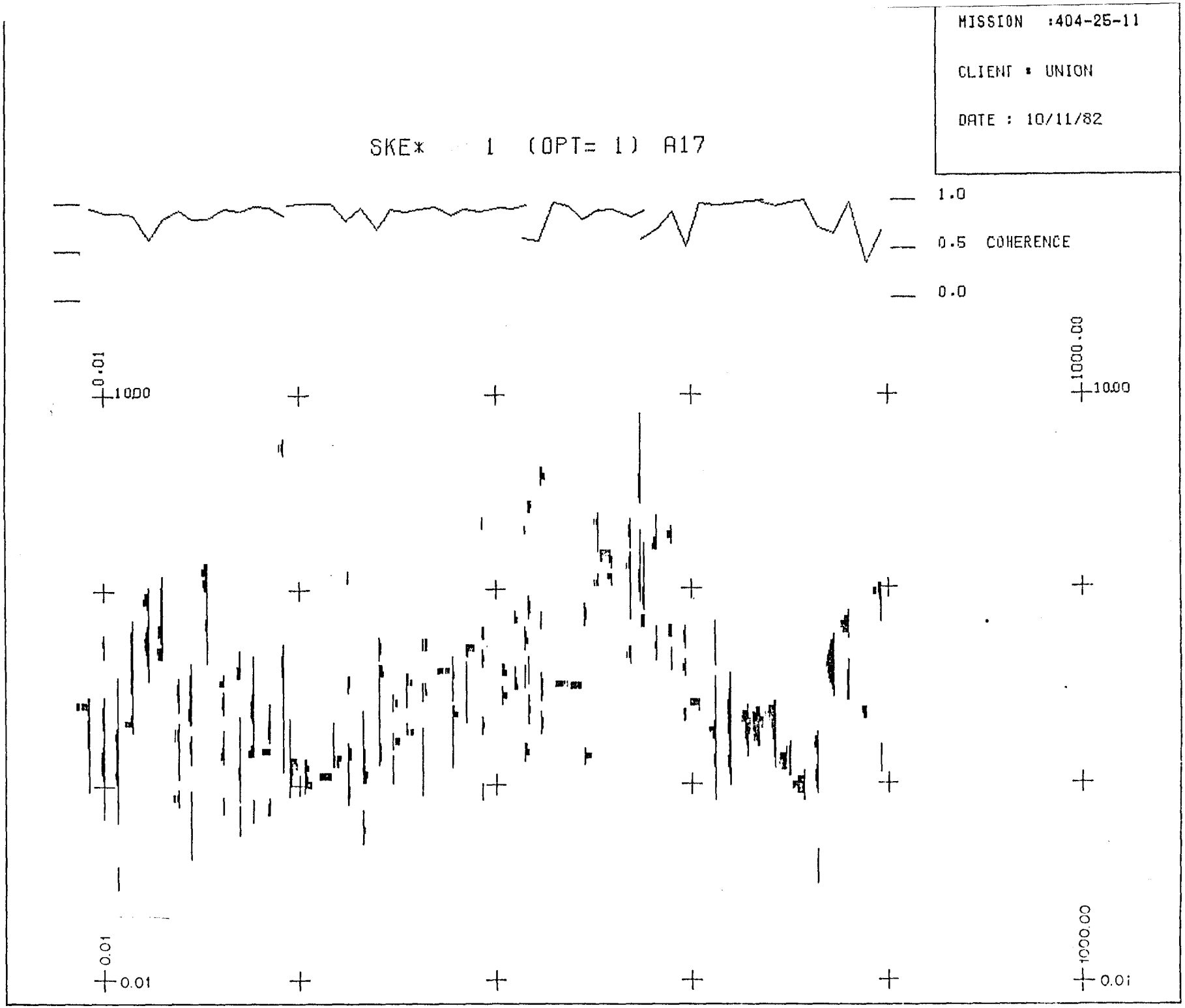

MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
RHO INV 2 (OPT= 1) A17
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

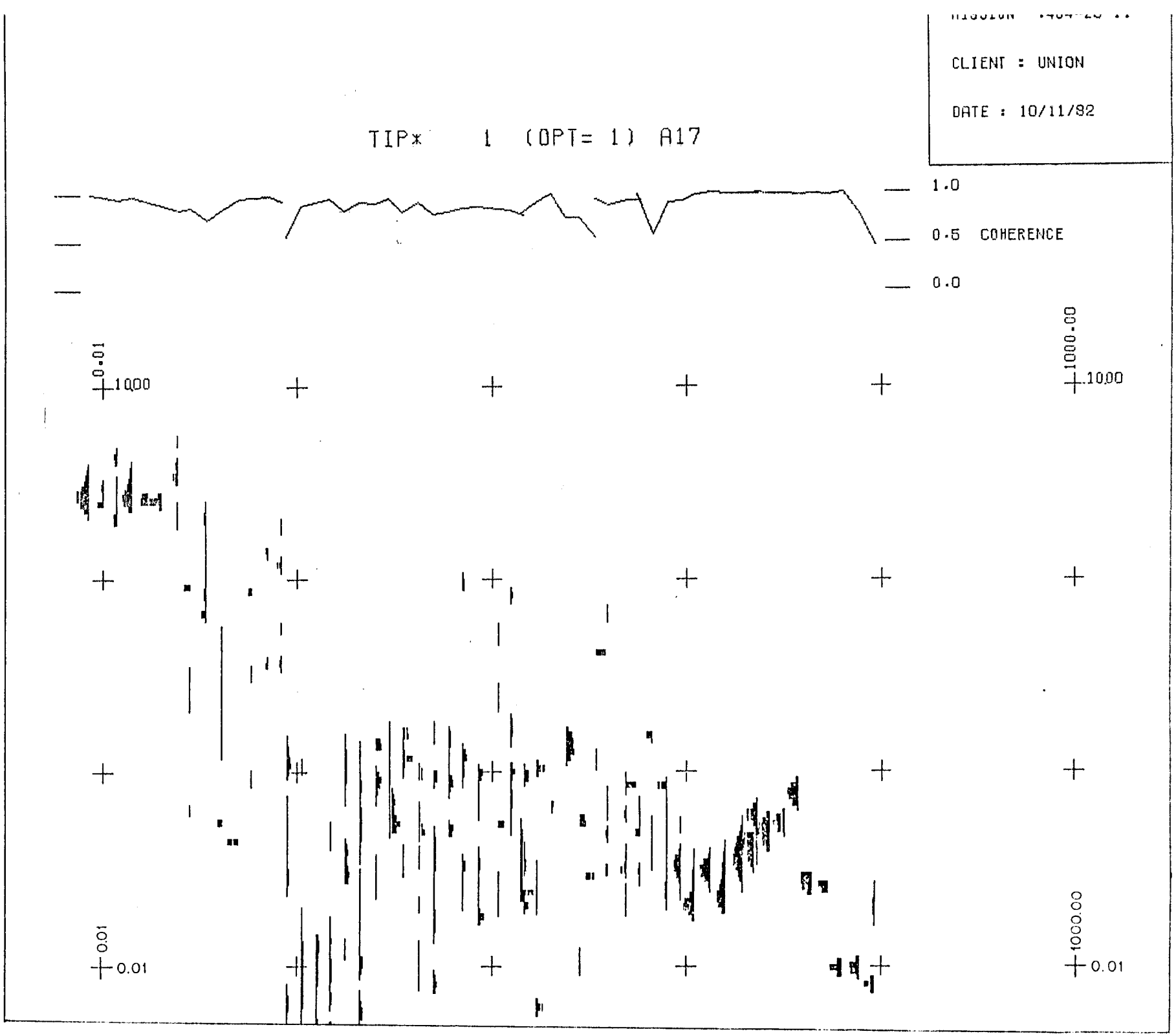

MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
RHO YX 1 0100 0100 0100 (OPT= 1) A17
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00

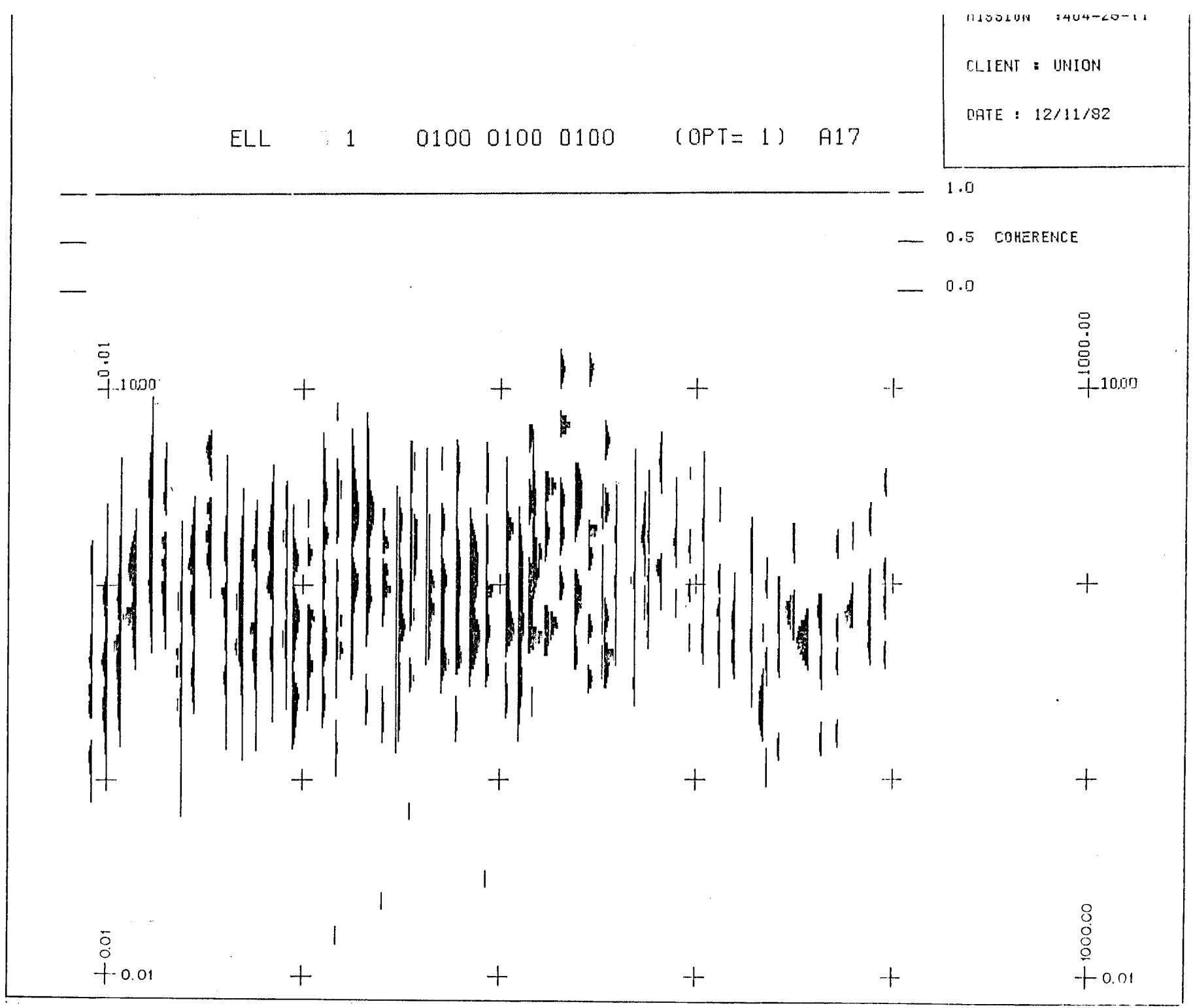

MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
PHA YX 1 0100 0100 0100 (OPT= 1) A17
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
RHO XY 1 0100 0100 0100 (OPT= 1) A17
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
1000.00
0.01
1.00
1000.00
1.00


MISSION :404-25-11
CLIENT : UNION
DATE : 12/11/82
PHA XY 1 0100 0100 0100 (OPT= 1) A17
1.0
0.5 COHERENCE
0.0
0.01
45.00
1000.00
45.00
0.01
45.00
1000.00
45.00


MISSION :404-25-11
CLIENT : UNION
DATE : 10/11/82
SKE* 1 (OPT= 1) A17
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
10.00
0.01
0.01
1000.00
0.01


CLIENT : UNION
DATE : 10/11/82
TIP* 1 (OPT= 1) A17
1.0
0.5 COHERENCE
0.0
0.01
1000.00
1000.00
0.01
0.01
1000.00
0.01

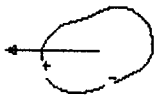

MISSION #404-26-11
CLIENT : UNION
DATE : 12/11/82
ELL 1 0100 0100 0100 (OPT= 1) A17
1.0
0.5 COHERENCE
0.0
0.01
10.00
0.01
0.01
1000.00
10.00
1000.00
0.01

MISSION : 1404-25-11
CLIENT : UNION
DATE : 19/11/82

DOMAINE BF
DECOUPAGE EN 16
TMIN = 11.13
TMAX = 23.27
AZIMUT EX 300gr
SKEW = 0.183
TIPPER = 0.197
COMBINAISON 1

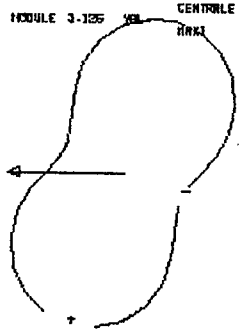
XY

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 180°
MAXI 91.5 AND ROT (MINIMUM) 110°



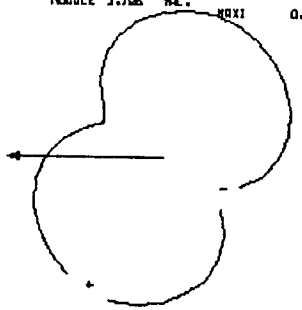
XX

MODULE 3.125 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 110°
MAXI 2.38 AND ROT (MINIMUM) 180°



YZ

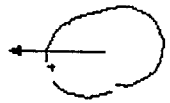
MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 210°
MAXI 0.197 AND ROT (MAXIMUM) 80°



SKEW = 0.176
TIPPER = 0.198
COMBINAISON 2

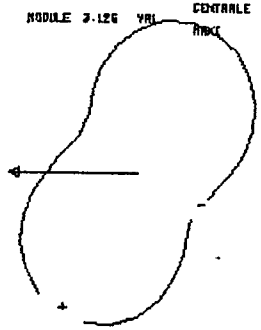
XY

MODULE 3.125 VAL. CENTRALE 10. AZIMUT DU MINIMUM 160°
MAXI 33.9 AND ROT (MINIMUM) 110°



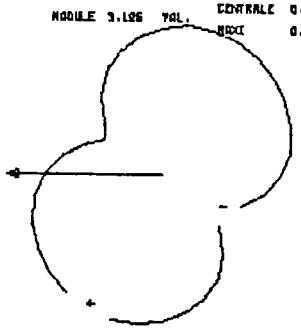
XX

MODULE 3.126 VAL. CENTRALE 0.1 AZIMUT DU MINIMUM 120°
MAXI 2.32 AND ROT (MINIMUM) 120°



YZ

MODULE 3.125 VAL. CENTRALE 0.01 AZIMUT DU MAXIMUM 210°
MAXI 0.198 AND ROT (MAXIMUM) 80°



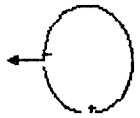
STATION RI7
DOMAINE MF
DECOUPAGE EN 24
TMIN = 0.10
TMAX = 0.60
AZIMUT EX 300gm
SKEW = 0.104
TIPPER = 0.057
COMBINAISON 1

MISSION : 404-23-41
CLIENT : UNION
DATE : 10/11/82

SKEW = 0.095
TIPPER = 0.024
COMBINAISON 2

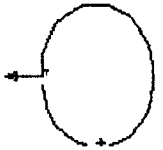
XY

MODULE 3.135 VAL. CENTRALE 100. AZIMUT DU MINIMUM 270°
MAXI 866.8 ANG ROT (MINIMUM) 0°



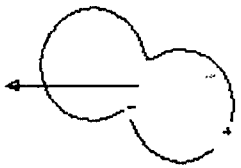
XY

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 270°
MAXI 403.2 ANG ROT (MINIMUM) 0°



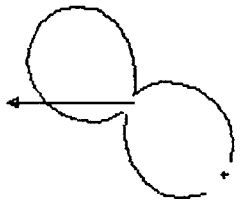
XX

MODULE 3.125 VAL. CENTRALE 1. AZIMUT DU MINIMUM 200°
MAXI 7.5 ANG ROT (MINIMUM) 70°



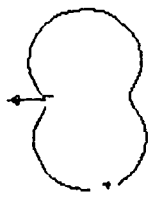
XX

MODULE 3.125 VAL. CENTRALE 1. AZIMUT DU MINIMUM 210°
MAXI 10.5 ANG ROT (MINIMUM) 60°



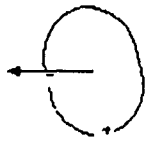
YZ

MODULE 3.125 VAL. CENTRALE 9.01 AZIMUT DU MAXIMUM 170°
MAXI 8.660 ANG ROT (MAXIMUM) 100°



YZ

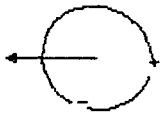
MODULE 3.135 VAL. CENTRALE 8.03 AZIMUT DU MAXIMUM 170°
MAXI 8.036 ANG ROT (MAXIMUM) 100°



DOMAINE MF
DECOUPAGE EN 59
TMIN = 0.04
TMAX = 0.08
AZIMUT EX 300
SKEW = 0.116
TIPPER = 0.149
COMBINAISON 1

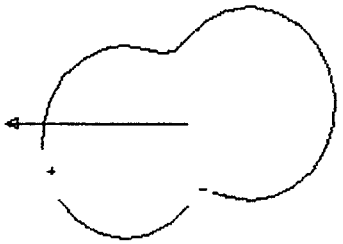
XY

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 100°
MAXI 286.9 AND ROT (MINIMUM) 70°



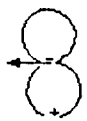
XX

MODULE 3.125 VAL. CENTRALE 1. AZIMUT DU MINIMUM 170°
MAXI 20.3 AND ROT (MINIMUM) 100°



YZ

MODULE 3.125 VAL. CENTRALE 0.1 AZIMUT DU MAXIMUM 100°
MAXI 0.20 AND ROT (MAXIMUM) 80°

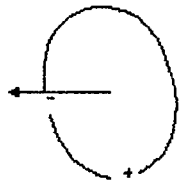


MISSION : 1404-85-11
CLIENT : UNION
DATE : 10/11/82

SKEW = 0.119
TIPPER = 0.386
COMBINAISON 2

XY

MODULE 3.125 VAL. CENTRALE 100. AZIMUT DU MINIMUM 280°
MAXI 649.6 AND ROT (MINIMUM) 10°

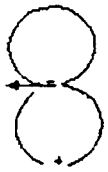


XX

MODULE 1.662 VAL. CENTRALE 1. AZIMUT DU MINIMUM 180°
MAXI 43.1 AND ROT (MINIMUM) 90°

YZ

MODULE 3.125 VAL. CENTRALE 0.1 AZIMUT DU MAXIMUM 180°
MAXI 8.47 AND ROT (MAXIMUM) 90°



# UNION OIL COMPANY OF CALIFORNIA

UNION GEOTHERMAL DIVISION

---

# MAGNETOTELLURIC SURVEY

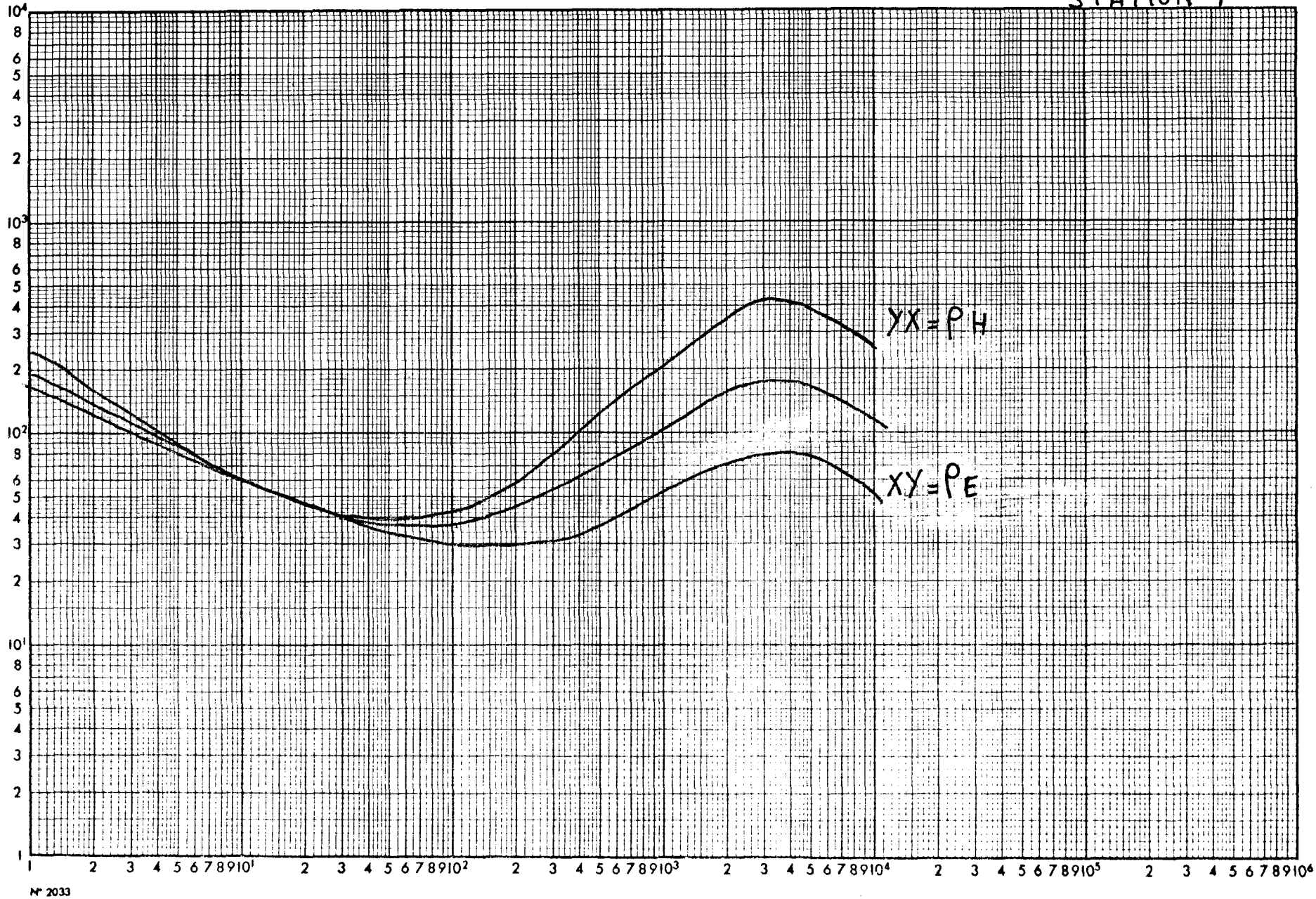
GLASS MOUNTAIN PROSPECT

OCTOBER, 1982

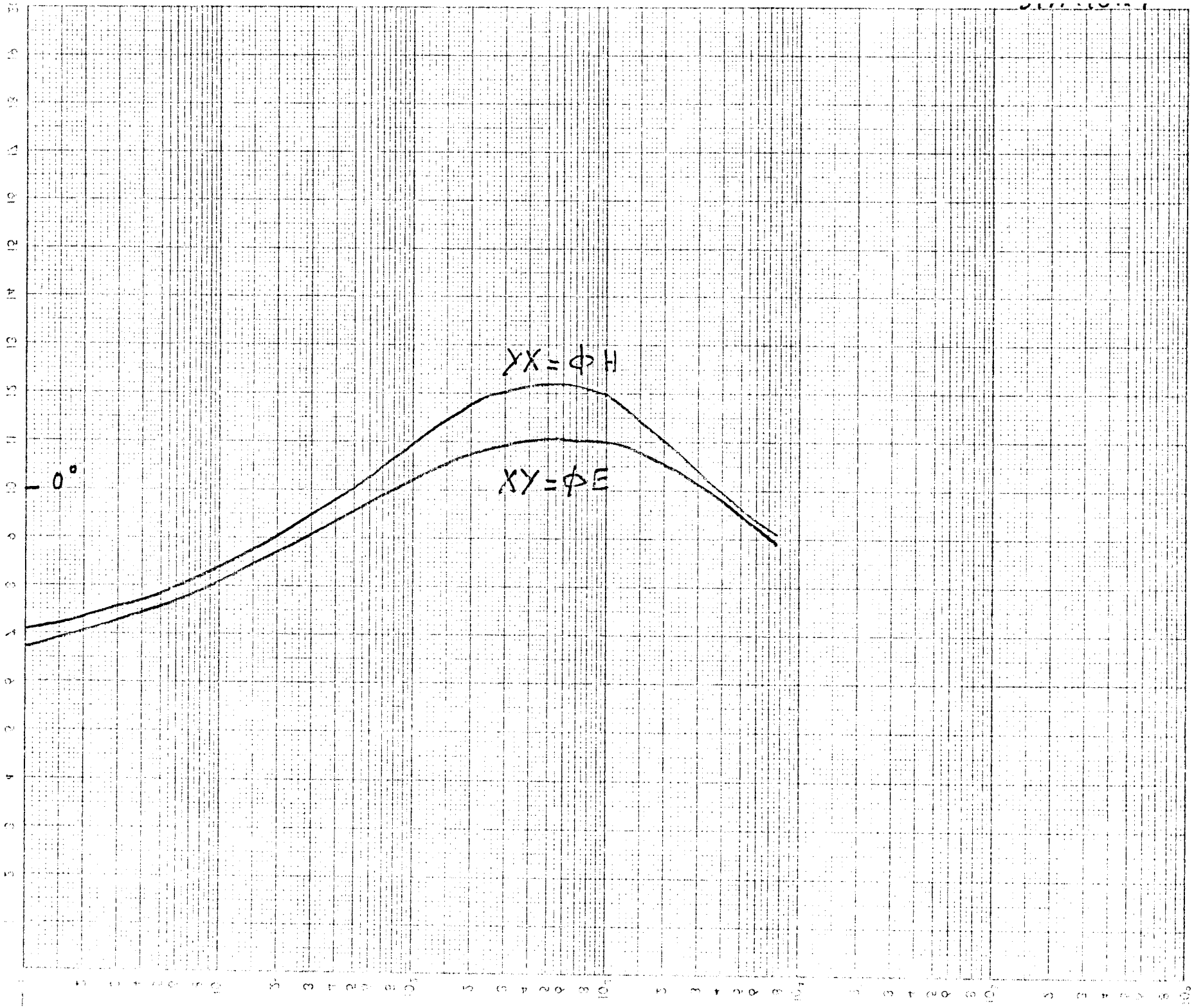
---

# ANNEX 2: AVERAGE DIAGRAMS

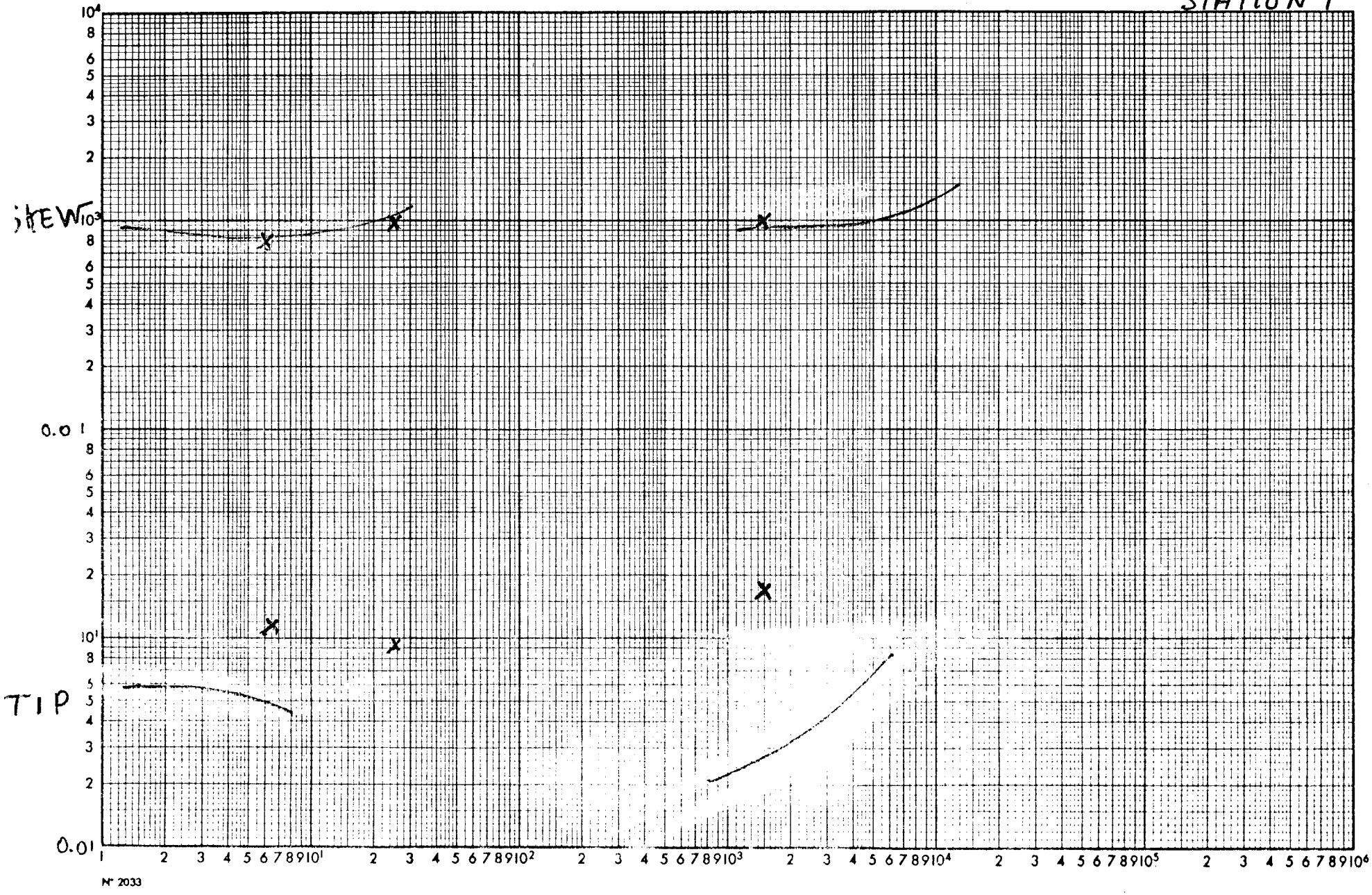
STATION 1




N° 2033


YX = ΦH
XY = ΦE
0°

STATION 1




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 25-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURI REPORT

Processing : Combined in [illegible] MTTE
(Mode ID)
Delete 8200 → (N-8200)
Σ

Sketch :

N

Station : 1

Tape : 4

+

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 10kr | 75gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 10kr | 375gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 70 | MF | Gain | 50 x 30 | 20 x 30 | 50 x 30 | 20 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | |
| 71 | HF | Gain | 50 x 30 | 20 x 30 | 50 x 30 | 20 x 30 | 20 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 72 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 10 x 3 | | 35' |
| | | Sensibil. | " | " | " | " | " | | |
| 73 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 10 x 3 | | 35' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Enregistrement mauv
Ne pas TRAITER
Signal très faible
"Pets" d'orage trop fré

Pluie - Vent - Neige.
"Pets" d'orage

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 26.10.82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

Station : 1

Tape : 4

+

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 7 kr | 75gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 7 kr | 375gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 74 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | |
| 75 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 76 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 20 x 3 | 10 x 3 | | 106' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Enregistrement mauvai

Ne pas TRAITER

Signal très faible en

"Pets" d'orage trop fr

Vent - Soleil et Nuage

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 27.10.82 | 404-25-11 | GLASS MT. | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

Station : 1

Tape : 4

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 7 kΩ | 75gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 7 kΩ | 375gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 77 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | | |
| 78 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 79 | BF | Gain | 50x30 | 10x3 | 50x30 | 20x3 | 10x3 | | 106' |
| | | Sensibil. | " | " | " | " | " | | |
| 80 | MF | Gain | 50x100 | 50x30 | 50x100 | 50x30 | 20x100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | |
| 81 | HF | Gain | 50x100 | 50x30 | 50x100 | 50x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

TRES BON SIGNAL

Pas de "Pets"

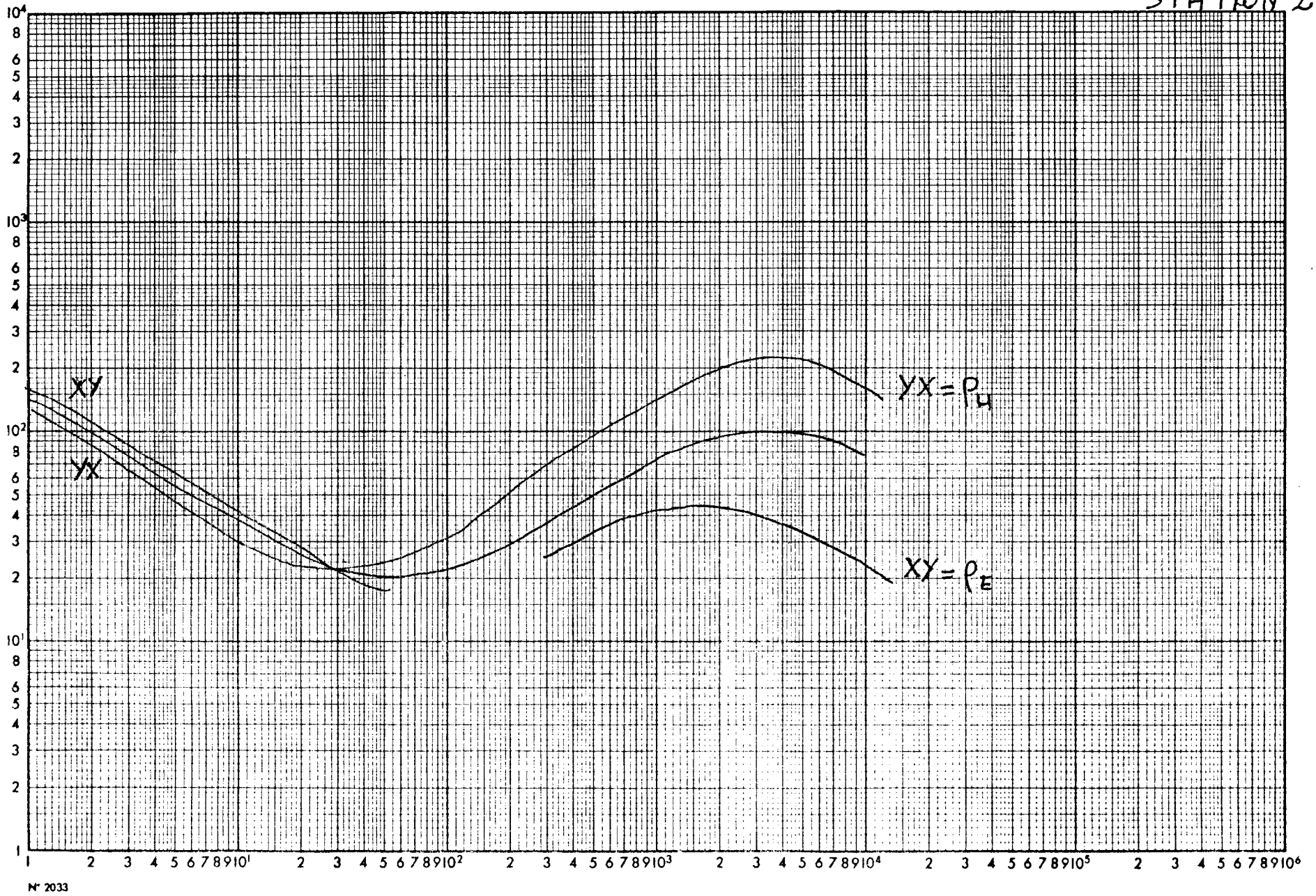
⊗

Soleil - Neige au sol - Pas de

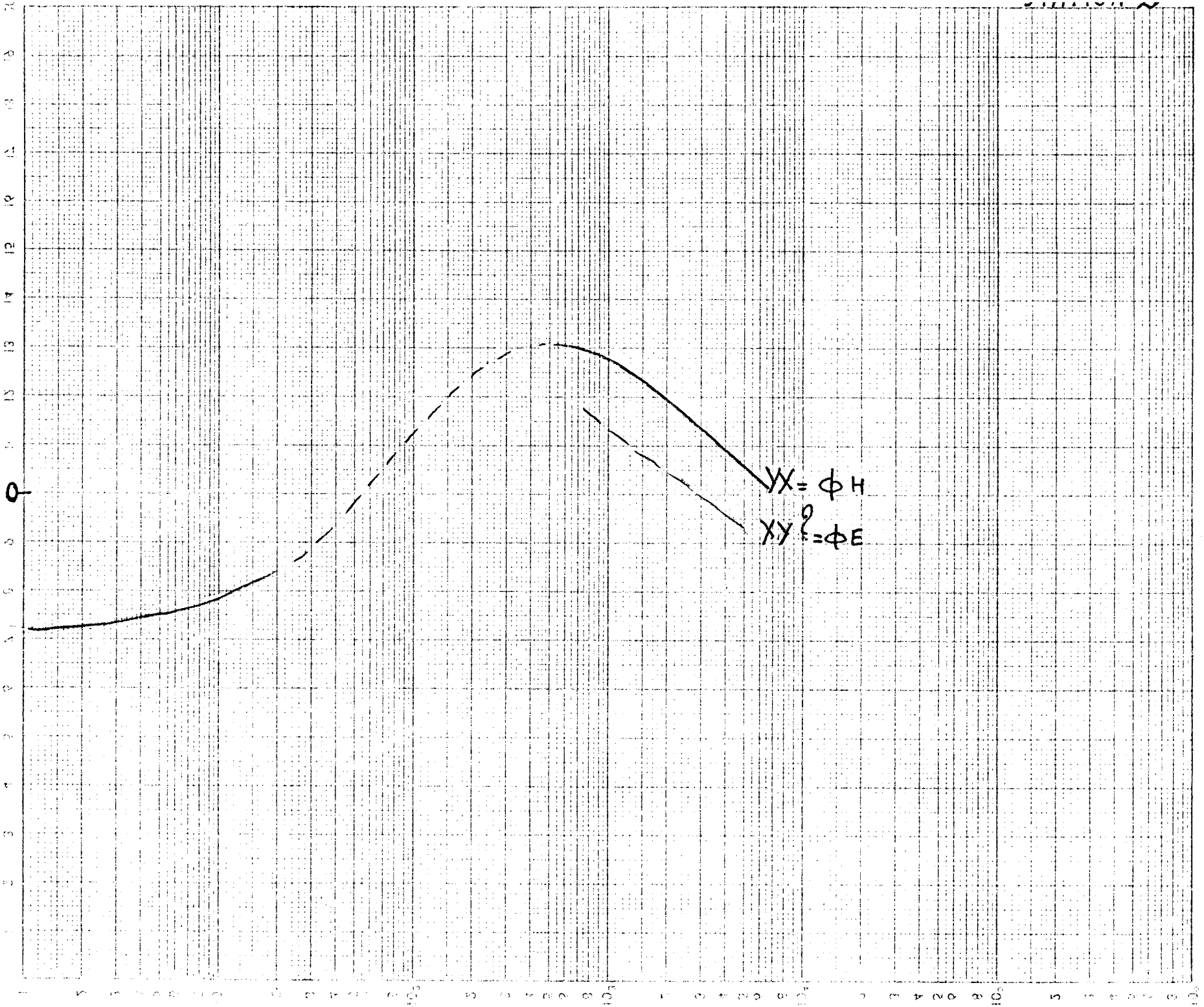
E.N.D.T. FIN de BANDE 4

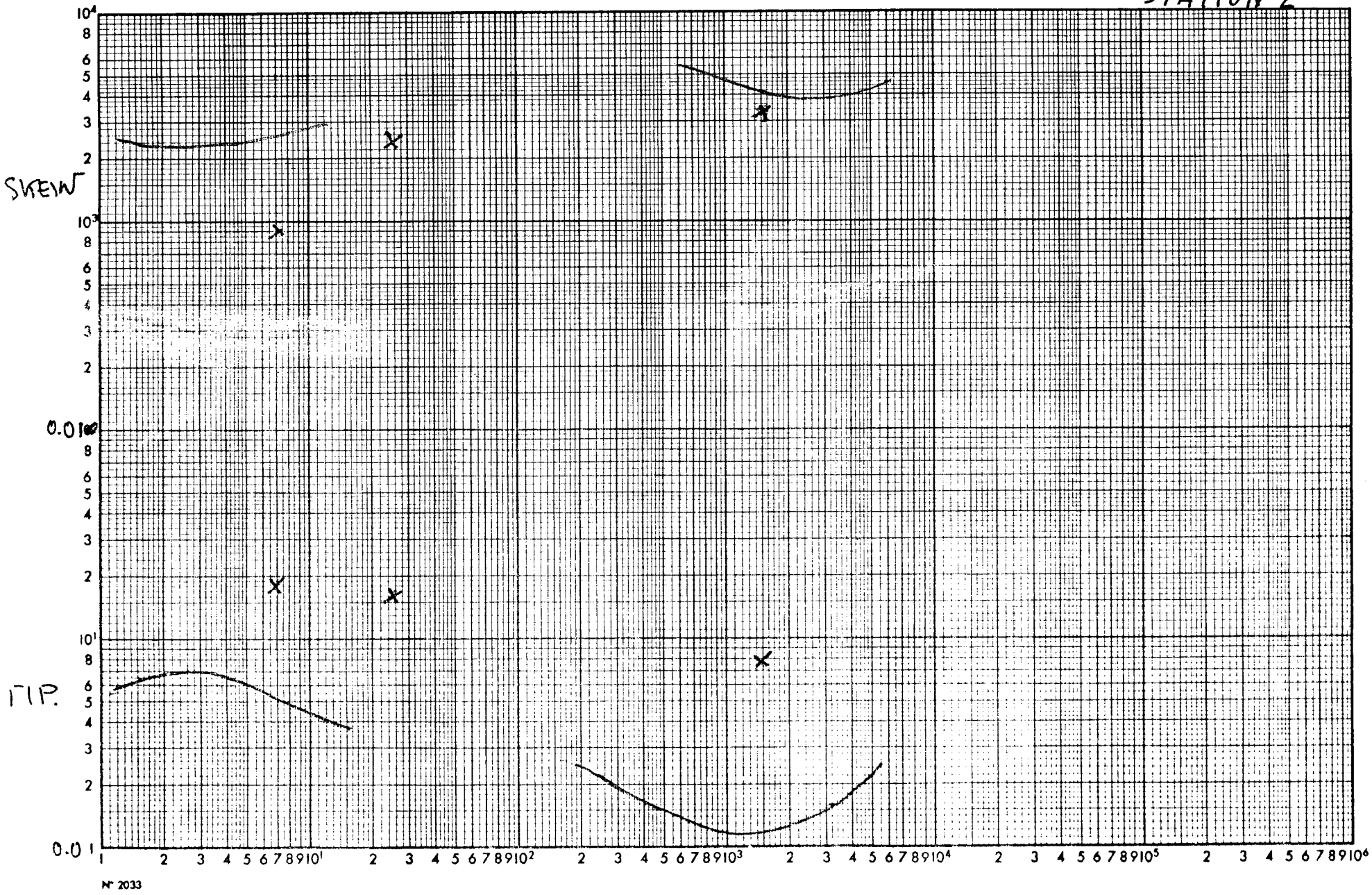
Station en Foret

STATION 2




N° 2033


0
YX = ϕH
XY ? = ϕE


STATION 2
SKEW
TIP.
$10^4$
$10^3$
0.01
$10^1$
0.01
1 2 3 4 5 6 7 8 9 $10^1$ 2 3 4 5 6 7 8 9 $10^2$ 2 3 4 5 6 7 8 9 $10^3$ 2 3 4 5 6 7 8 9 $10^4$ 2 3 4 5 6 7 8 9 $10^5$ 2 3 4 5 6 7 8 9 $10^6$
N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 28-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURI REPORT

Processing : 16h35 17h10 17h44 17h59
Temps échantillon
N

BF Date 8650 - 16850 (17 - 5200)

MF1 Dérive 15 3[illegible] - N

Sketch :

N

Station : 2

Tape : 5

+

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 445' | 10kΩ | 355gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 515' | 10kΩ | 255gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 12 | MF | Gain | 20x300 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | | |
| 13 | HF | Gain | 20x300 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 14 | BF | Gain | 20x100 | 10x3 | 20x100 | 20x3 | 10x3 | | 107' |
| | | Sensibil. | " | " | " | " | " | | |
| 15 | MF | Gain | 20x300 | 20x30 | 20x300 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | ⊗ |
| 16 | HF | Gain | 20x300 | 20x30 | 20x300 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

7[illegible] Ey !!

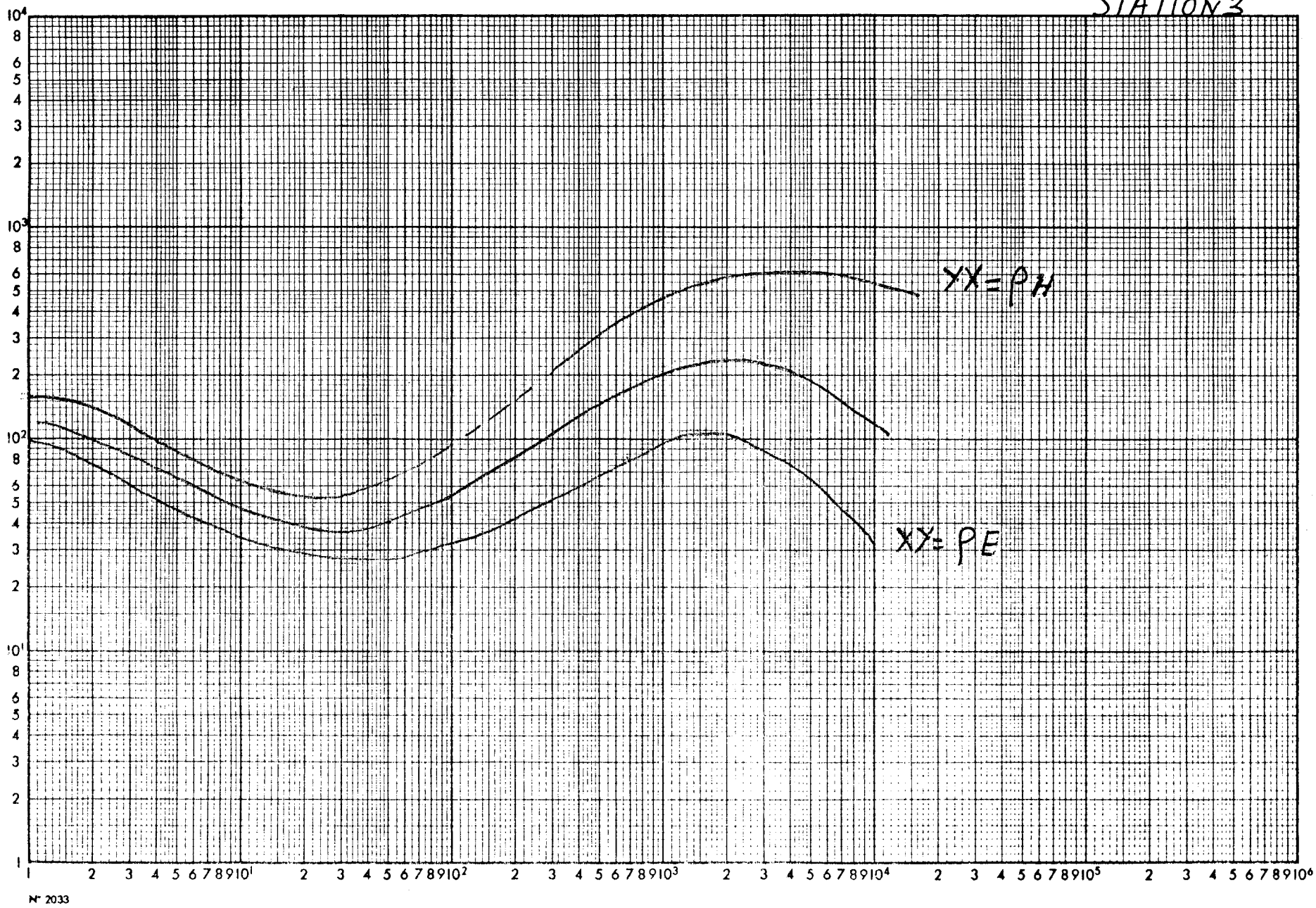
Signal moyen . Ex.Hy → o.k
Ey.Hx → ma
corrélat

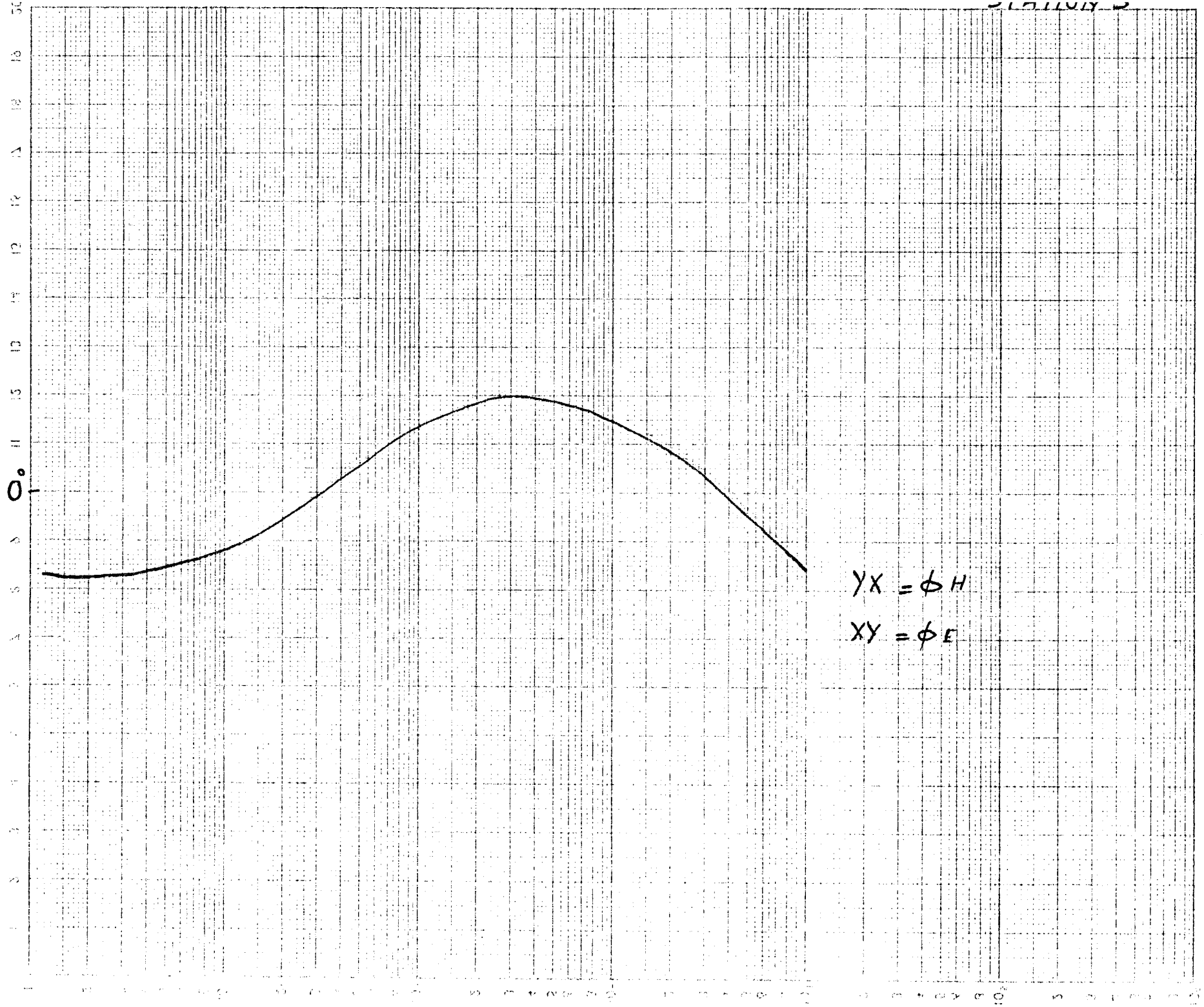
Decrochements sur Ey

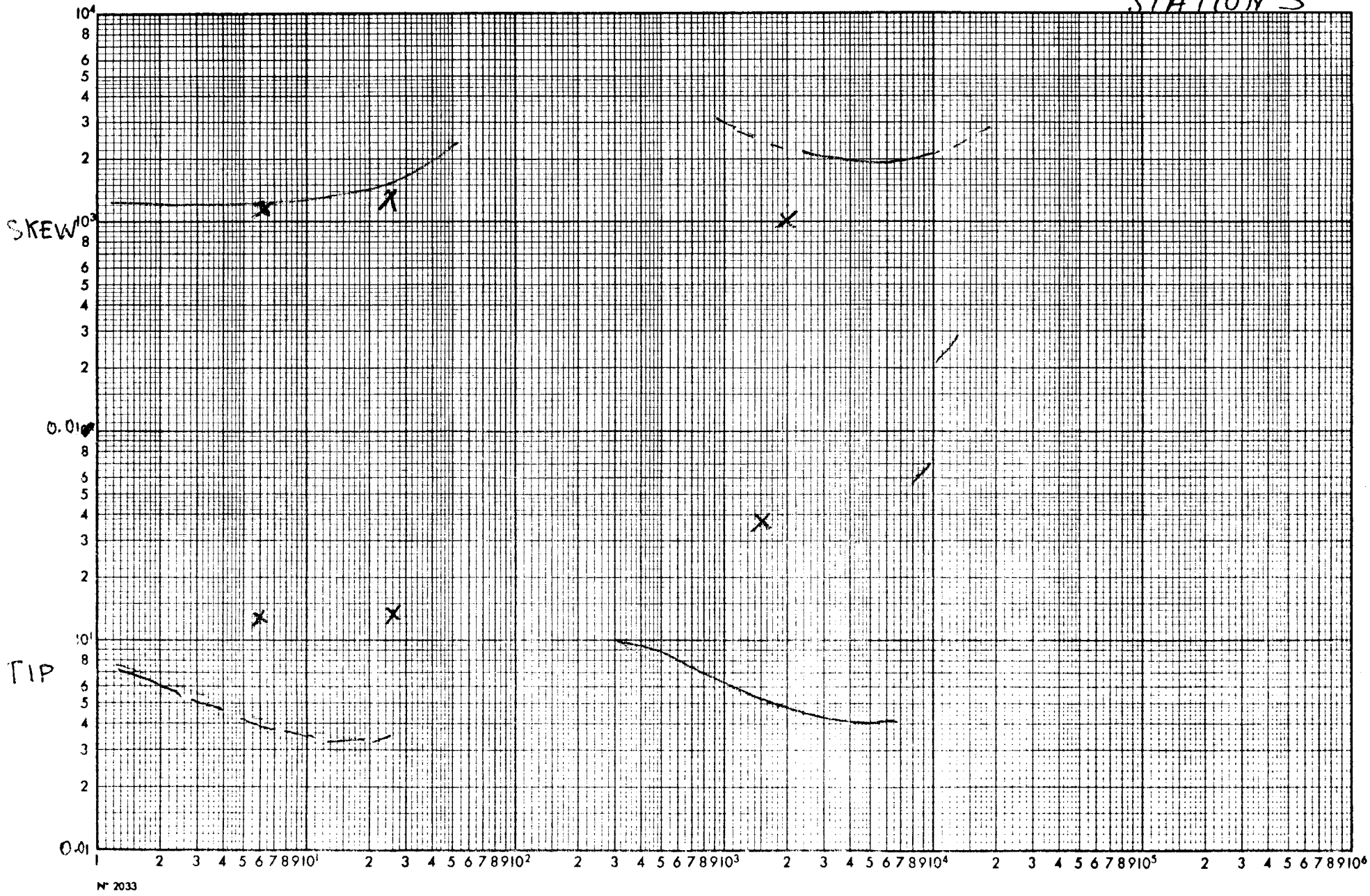
Ne pas TRAITER la mn
les 1ers 35mn, puis les 2e
(Recentrage Signal)

Sol en Pierre Ponce - Station a cote d'une coulee
10cm de Neige - Pluie et Gresil Vent.

Coulée et Maars sur Plate forme dégagée


STATION 3
YX = ρH
XY = ρE
10⁴
10³
10²
10¹
1
1 2 3 4 5 6 7 8 9 10¹ 2 3 4 5 6 7 8 9 10² 2 3 4 5 6 7 8 9 10³ 2 3 4 5 6 7 8 9 10⁴ 2 3 4 5 6 7 8 9 10⁵ 2 3 4 5 6 7 8 9 10⁶
N° 2033


0°
YX = ϕ H
XY = ϕ E


STATION 3
SKEW
TIP
$10^4$
$10^3$
0.01
$10^1$
0.01
1 2 3 4 5 6 7 8 9 $10^1$ 2 3 4 5 6 7 8 9 $10^2$ 2 3 4 5 6 7 8 9 $10^3$ 2 3 4 5 6 7 8 9 $10^4$ 2 3 4 5 6 7 8 9 $10^5$ 2 3 4 5 6 7 8 9 $10^6$
N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 23-10-82 | 4041211 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch : N

Station : 3

Tape : 4

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 8kΩ | 35gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 530' | 6kΩ | 335gr | Ey | | | Hy |

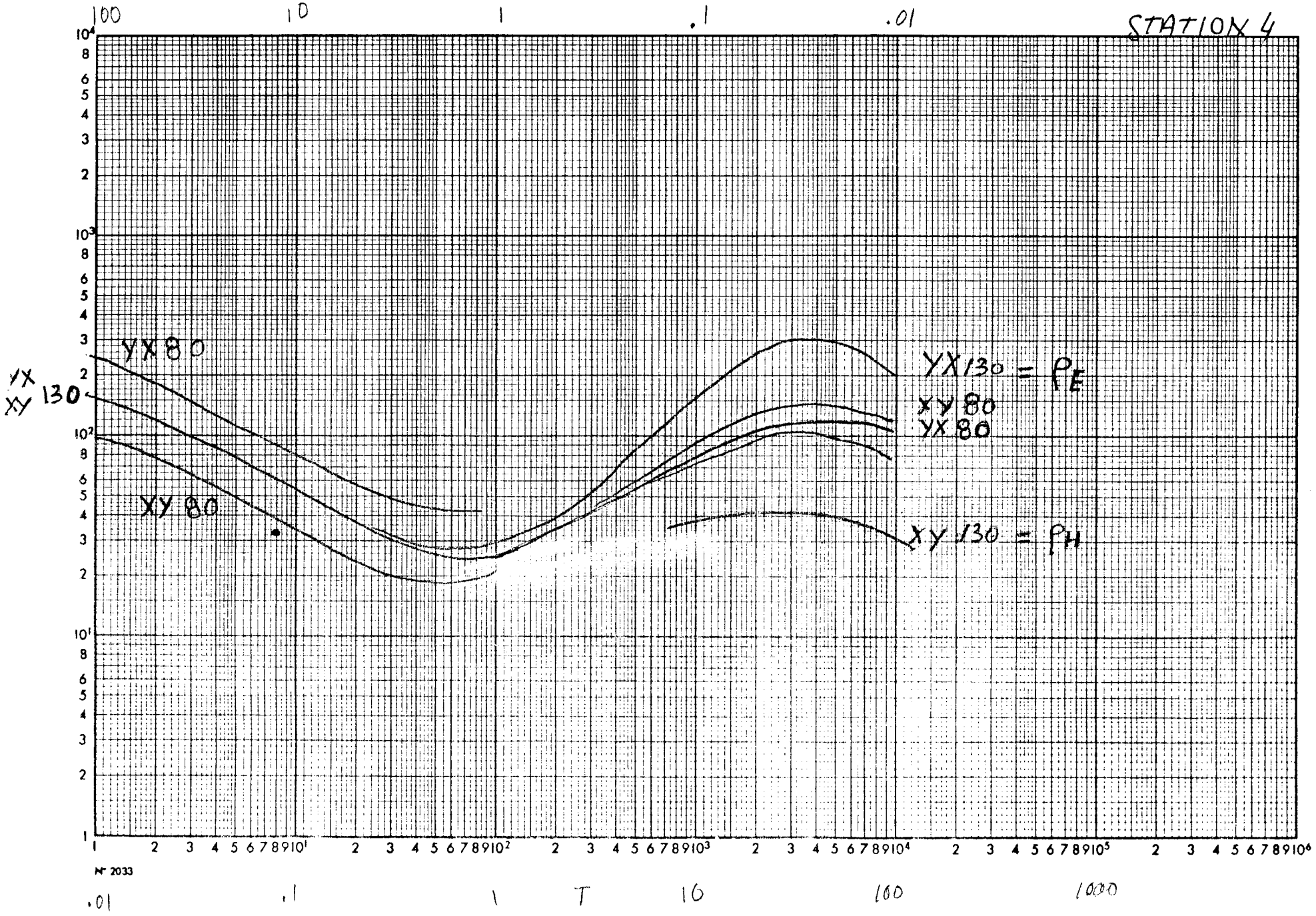
| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 65 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | | |
| 66 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 67 | BF | Gain | 50x30 | 10x3 | 50x30 | 10x3 | 10x3 | | 107' |
| | | Sensibil. | " | " | " | " | " | | |
| 68 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | |
| 69 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

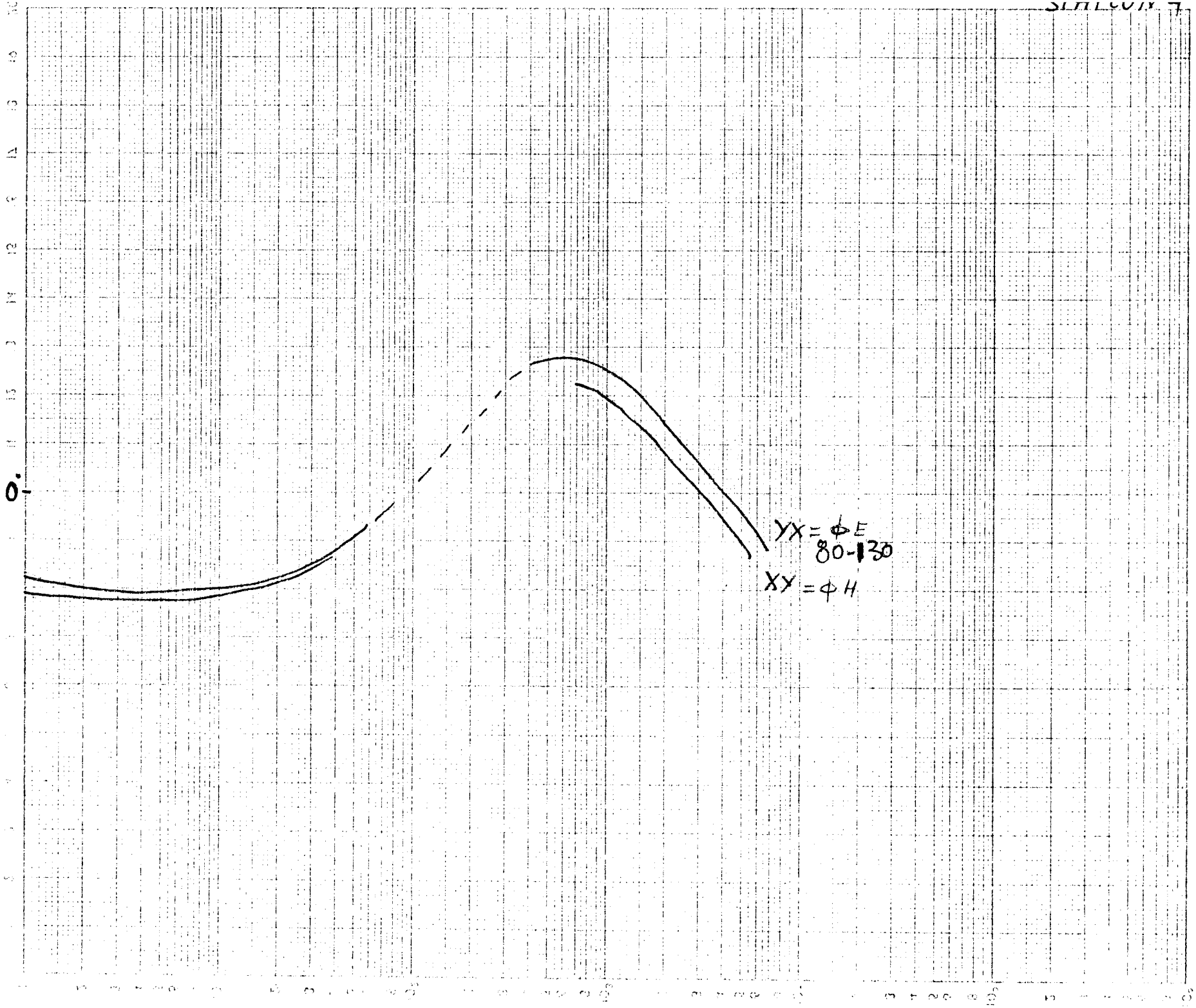
Remarks :

Ne pas prendre les 2 mm suiva
1e 35 mm (Saturation Hz, Recentr
⊗ les 2e 35 mm sont asse
les 1e et 3e : signal fa
Tellu assez instable

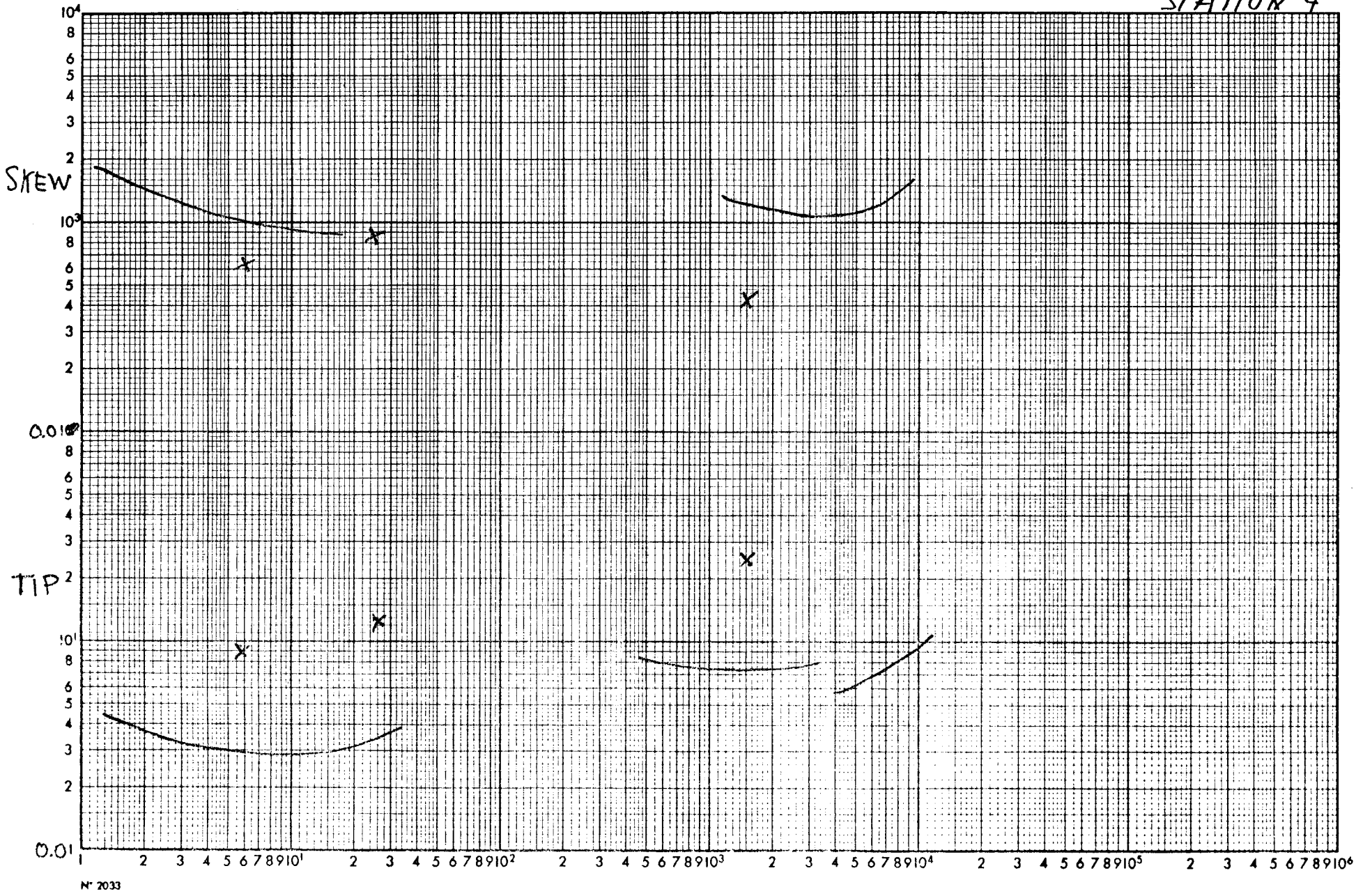
Nuageux - orageux - Vent.

Station en Foret.


STATION 4
100
10
1
.1
.01
YX 80
YX
XY 130
XY 80
YX130 = ρE
XY 80
YX 80
XY 130 = ρH
N° 2033
.01
.1
1
T
10
100
1000


0
YX = ϕE
80-130
XY = ϕH

STATION 4




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 28-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

Station : 4

Tape : 5

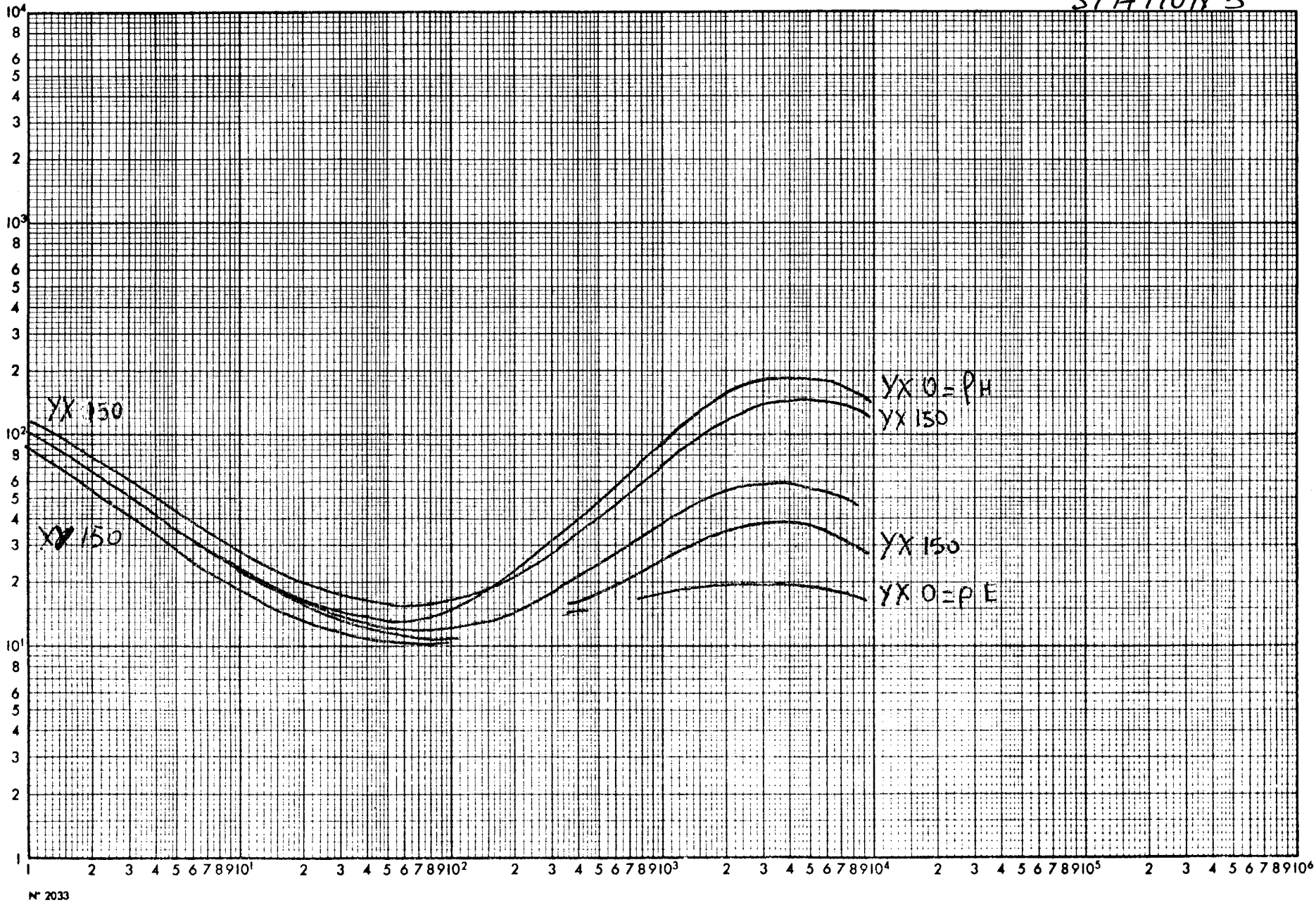
| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 437' | 17 kΩ | 75gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 26 kΩ | 375gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | MF | Gain | 20x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' | ⊗ |
| | | Sensibil. | 1 | 50mV/F | 1 | 50mV/F | 50mV/F | | | |
| 7 | HF | Gain | 20x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 8 | BF | Gain | 50x30 | 10x3 | 50x30 | 10x3 | 10x3 | | 1-10' | Ne pas TRAITER la mn qui a 1° 35mn, puis la mn qui a 2° 35mn (Recentrage Signal |
| | | Sensibil. | " | " | " | " | " | | | |
| 9 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 7' | Petits decrochements sur Ey Bon Signal. |
| | | Sensibil. | " | " | " | " | " | | | |
| 10 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 11 | BF | Gain | 50x30 | 10x3 | 50x30 | 20x3 | 10x3 | | 35' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | |

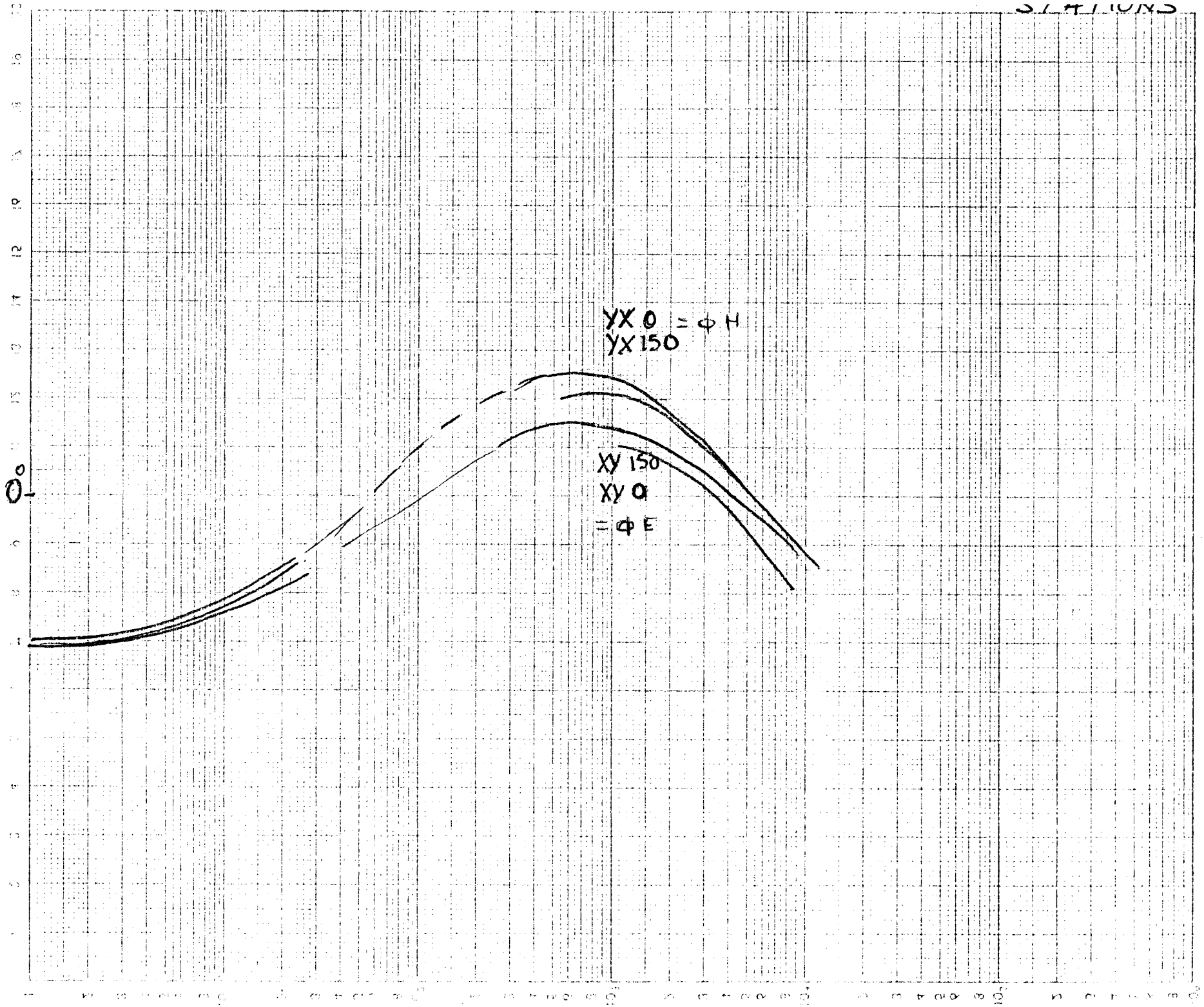
Station en Foret

Sol en pierre Ponce. Station a coté d'une combe de la

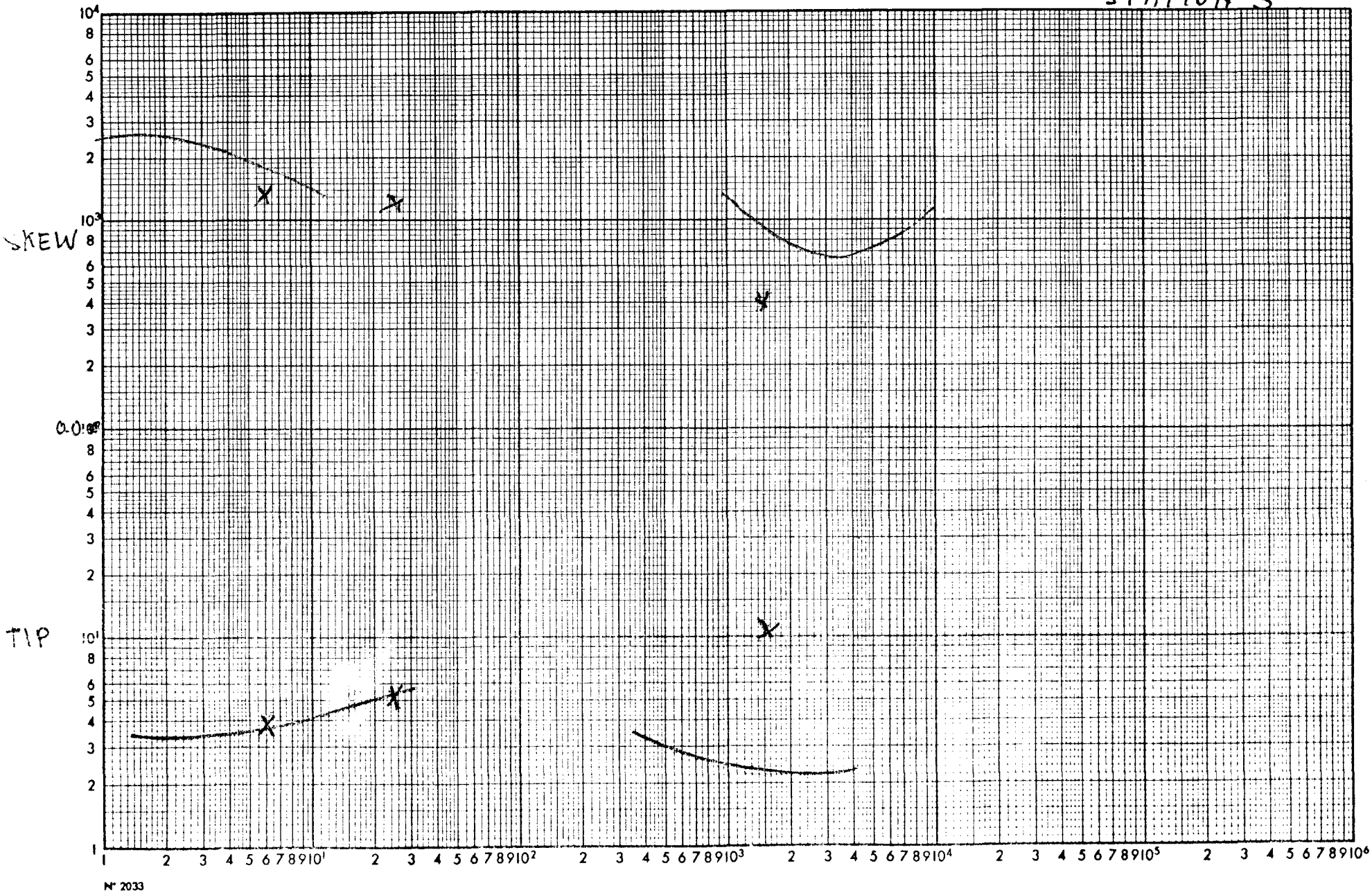
STATION 5




N° 2033


YX 0 = Φ H
YX 150
XY 150
XY 0
= Φ E

STATION 5




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 27.10.82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURI REPORT

Station : 5

Tape : 5

Processing :

A. Fcoef + 2 + 3 → Delete 16 km → (N - 8 200)

→ B. – 4 + 5 + 3 → Delete 8 300 → 15

?

Sketch :

N

2620

650' : 167.64 m

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 550' | 5 kΩ | 235 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500 | 5 kΩ | 135 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 1 | MF | Gain | 20 x 300 | 50 x 30 | 50 x 100 | 50 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | 1 | 50 mV/γ | 1 | 50 mV/γ | 50 mV/γ | | |
| 2 | HF | Gain | 20 x 300 | 50 x 30 | 50 x 100 | 50 x 30 | 20 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| 3 | BF | Gain | 20 x 30 | 20 x 1 | 20 x 30 | 10 x 3 | 10 x 3 | | 110' |
| | | Sensibil. | " | " | " | " | " | | |
| 4 | MF | Gain | 20 x 300 | 50 x 30 | 20 x 300 | 50 x 30 | 50 x 100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | |
| 5 | HF | Gain | 20 x 300 | 50 x 30 | 20 x 300 | 50 x 30 | 50 x 100 | | 1' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

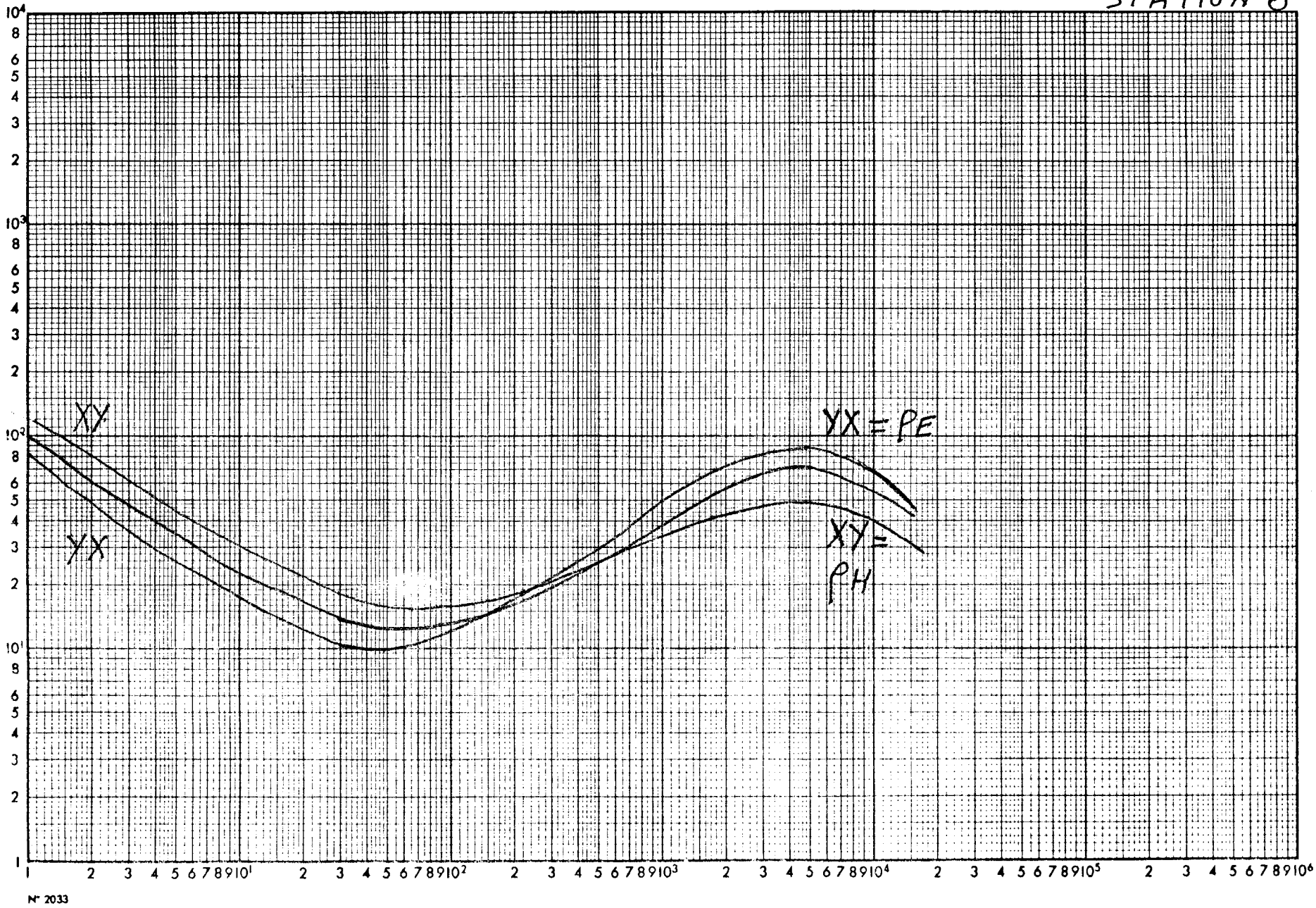
- Ne pas traiter les 4 mn qui les 2 premières 35 mn (Mariap
- Petits décrochements sur Ex ?

⊗

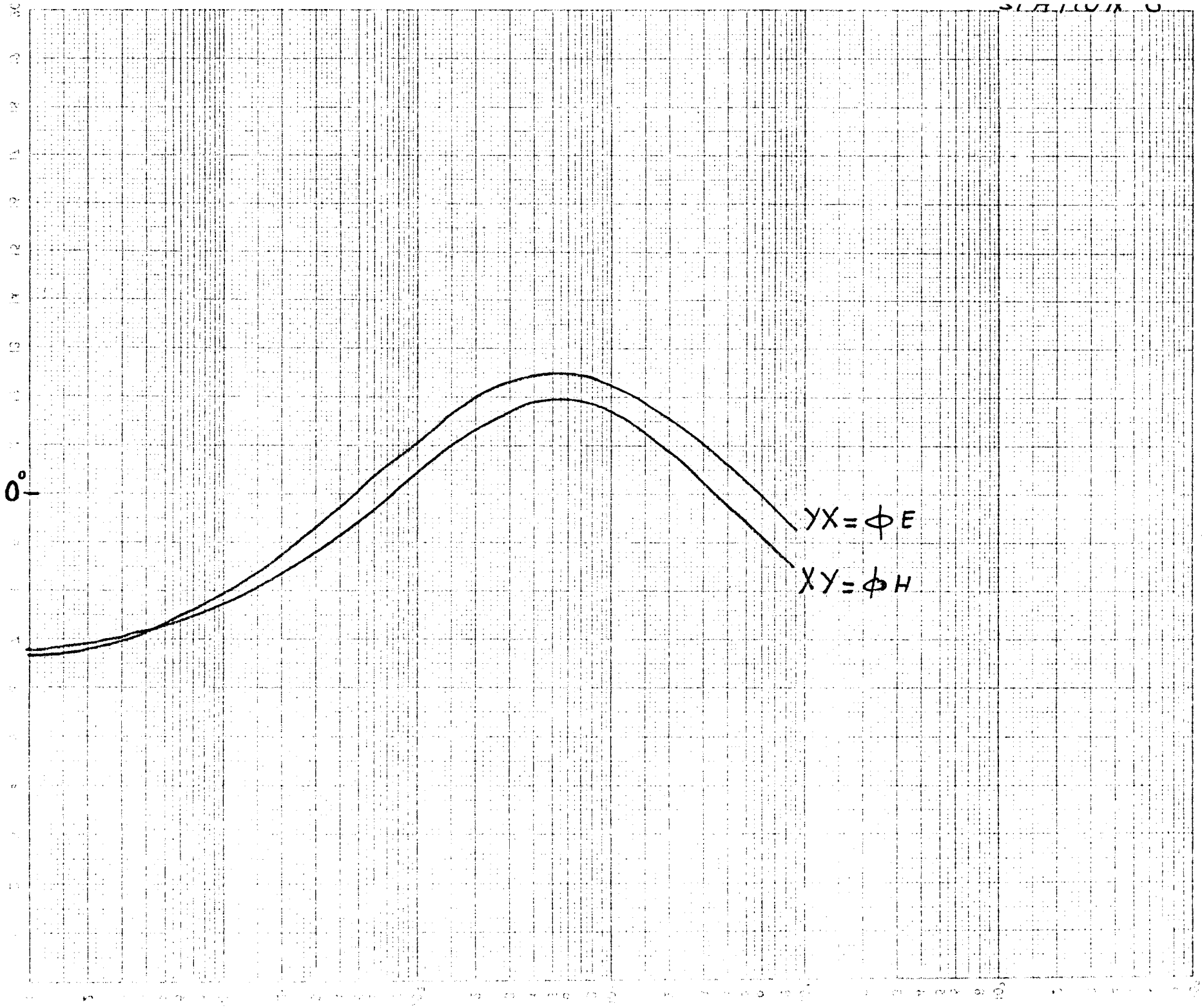
Soleil – Pas de vent. Neig sol fondante.

Stat : [illegible]

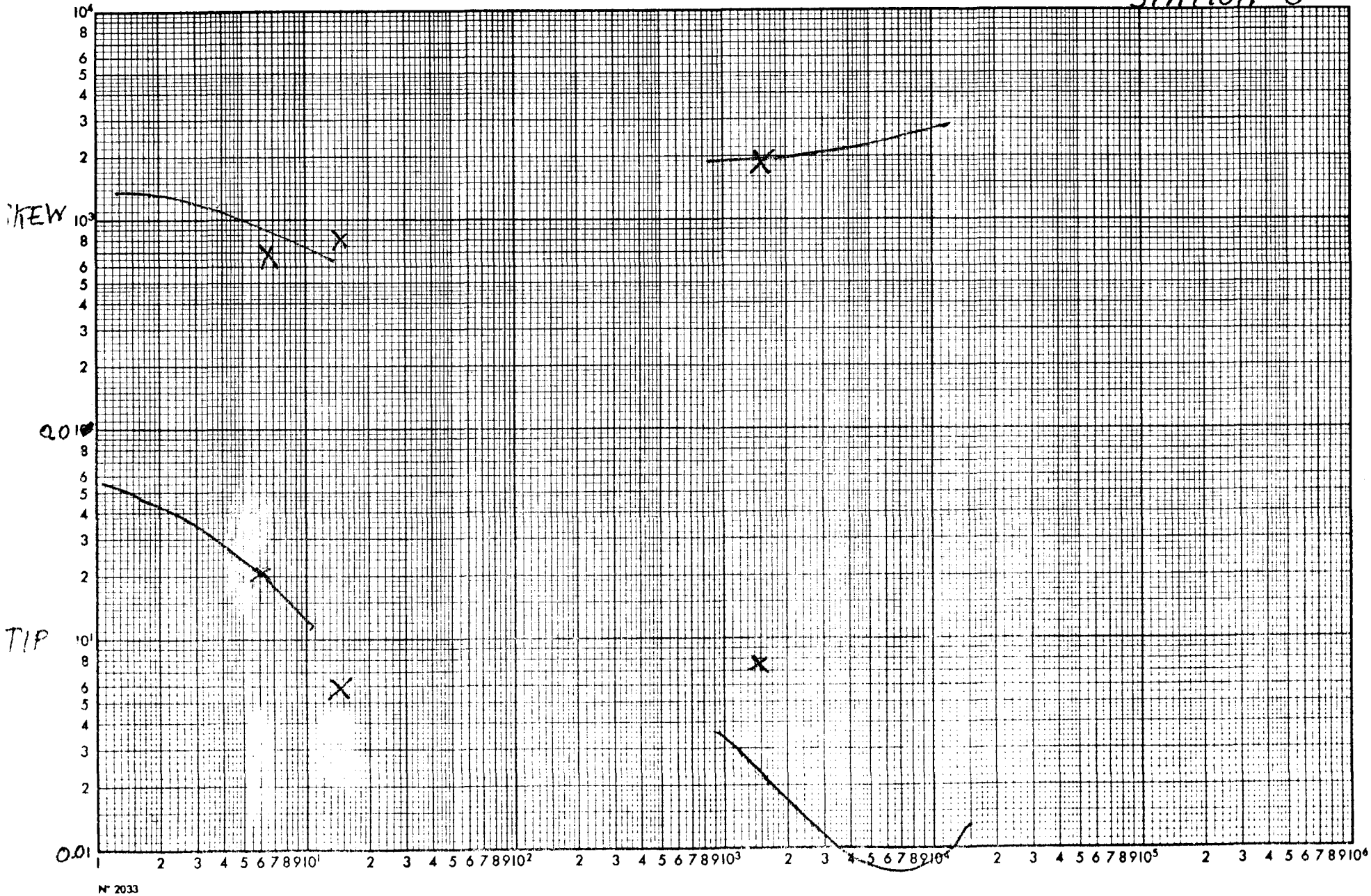
STATION 6




N° 2033


0°
YX = ϕE
XY = ϕH

STATION 6


SKEW
TIP
0.01
0.01
1 2 3 4 5 6 7 8 9 10¹ 2 3 4 5 6 7 8 9 10² 2 3 4 5 6 7 8 9 10³ 2 3 4 5 6 7 8 9 10⁴ 2 3 4 5 6 7 8 9 10⁵ 2 3 4 5 6 7 8 9 10⁶
N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 18-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

- Sur Ey : denivellé de ≃ + 30m entre le centre et electrode lointaine.
- Ey = 550'

Station : 6

Tape : 2




| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | EX | HY | EY | HX | HZ | | 500' | 10kΩ | 200gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 550' | 10kΩ | 100gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 32 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | 1 | 50mV/∫ | 1 | 50mV/∫ | 10mV/∫ * | | ⊗ |
| 33 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 11 |
| | | Sensibil. | " | " | " | " | " | | |
| 34 | BF | Gain | 20 x 30 | 10 x 3 | 20 x 30 | 10 x 3 | 10 x 10 | | 10 7' |
| | | Sensibil. | " | " | " | " | " | | |
| 35 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' |
| | | Sensibil. | " | " | " | " | " | | |
| 36 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

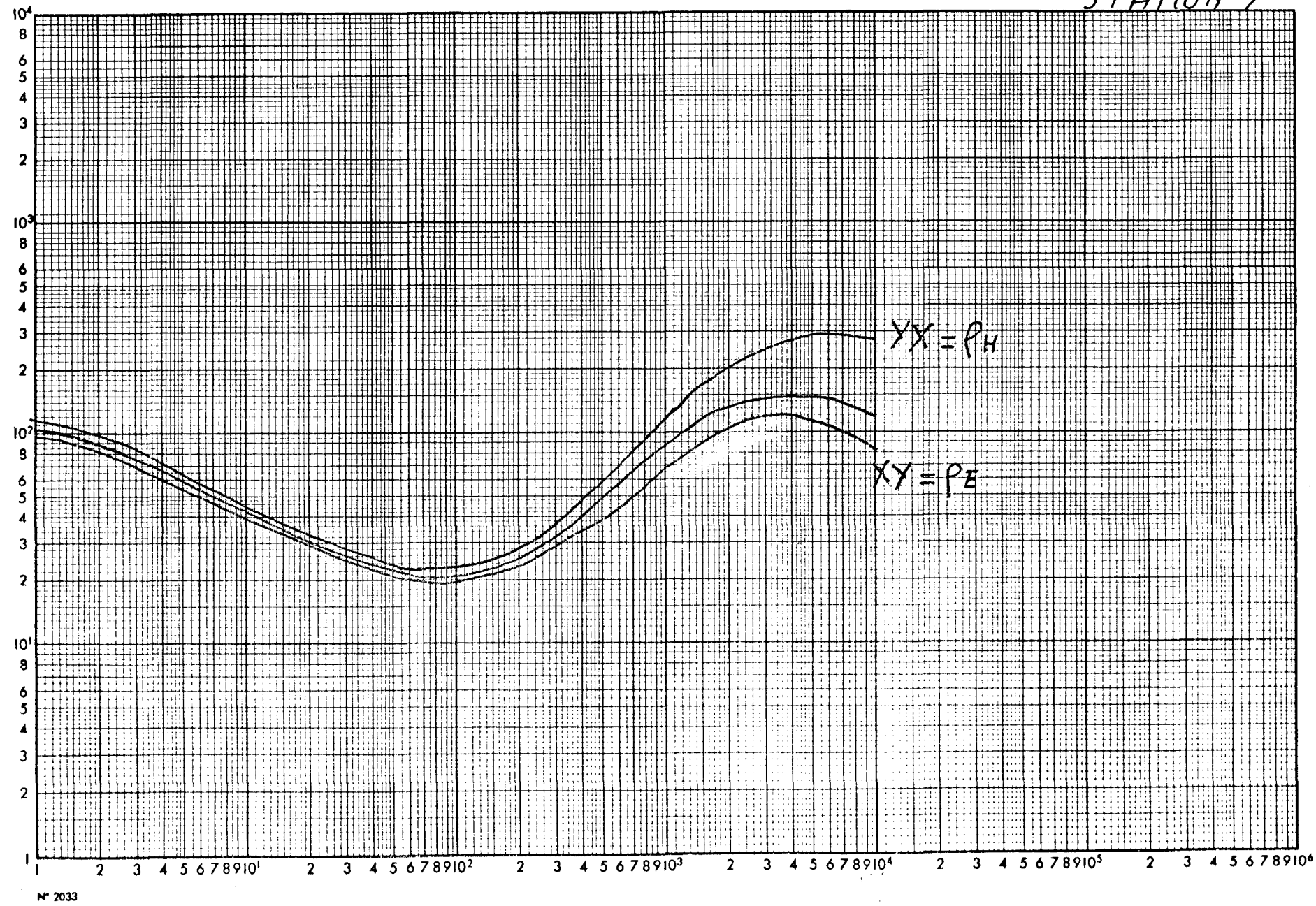
* Le Mag ne fonctionne plus en gamme "RAPIDE" → d'ou pas de travail en gamme "LENTE"
- quelques petits pets sur Tellu

TRES BON SIGAL

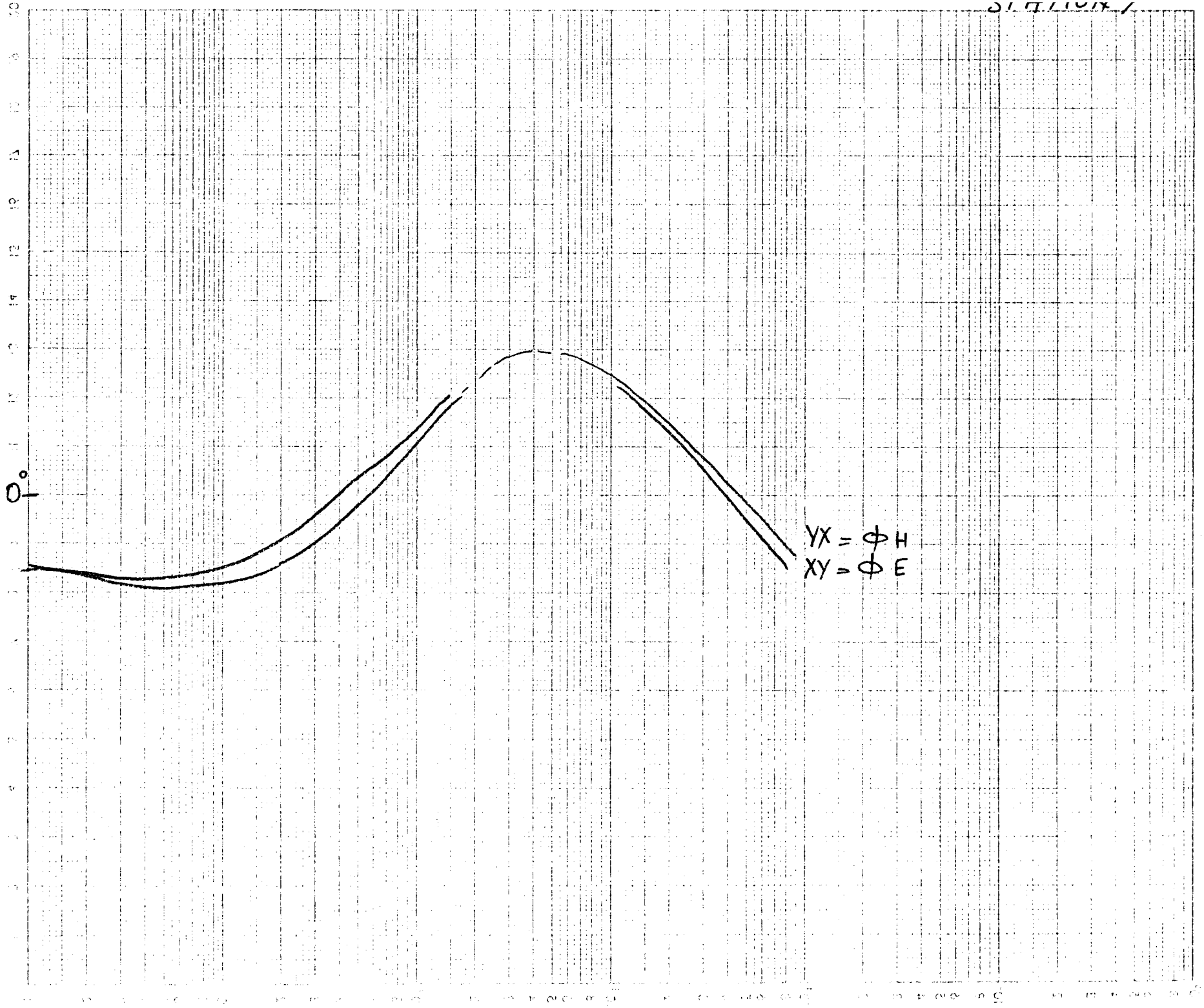
2 gros "pets" sur les Tellu

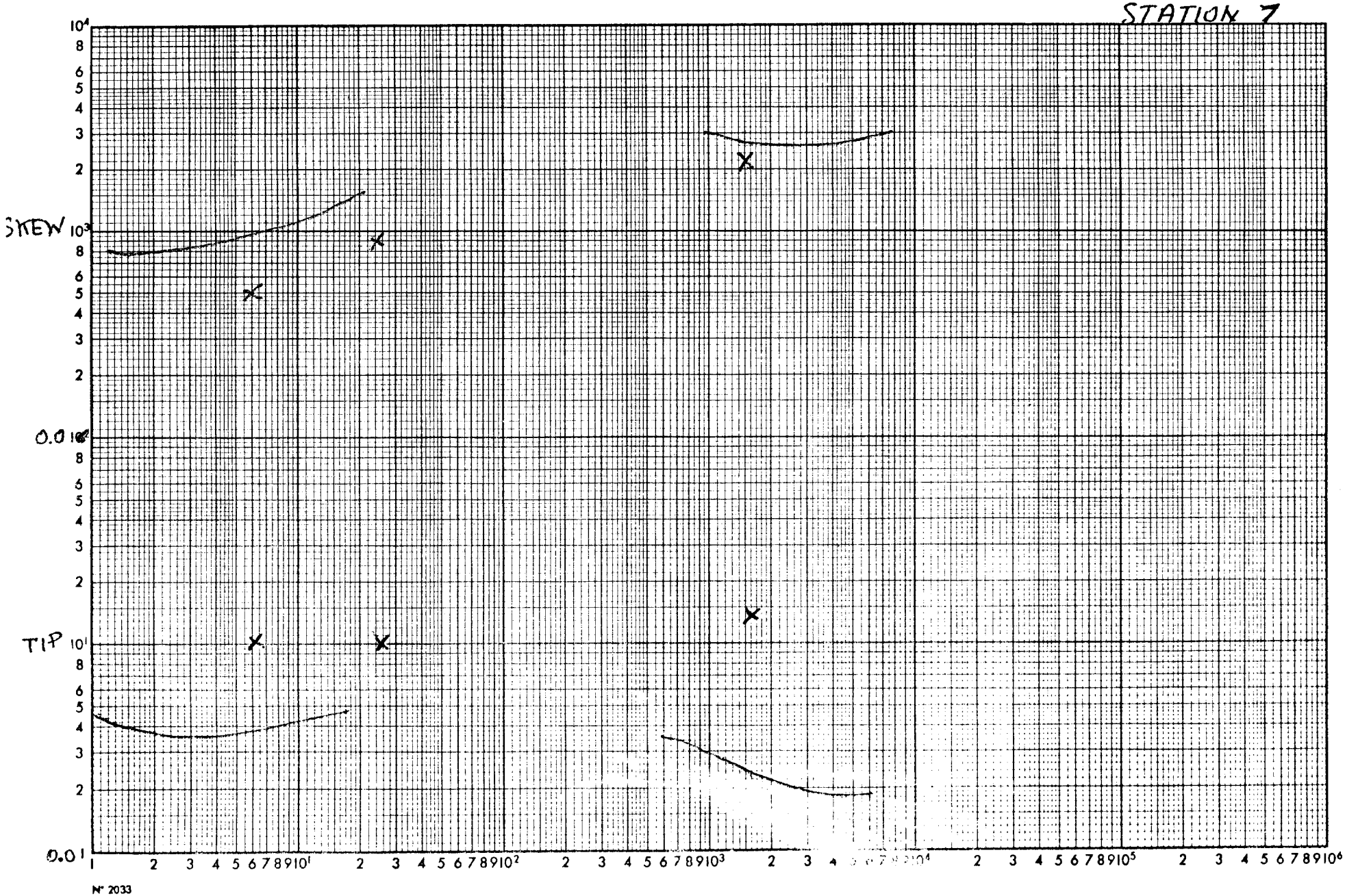
Ciel bleu - Vent léger.

STATION 7




N° 2033


0°
YX = Φ H
XY = Φ E


STATION 7
SKEW
TIP
0.01
0.01
N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 22-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURI REPORT

Processing : ...ELLIPSE 8200 - N

D = 59.6 ... 2

... 4 0 MIN

C 6360 - ... ELLIPSE 8200 - E

17845

Sketch :

N

Station : 7 /

Tape : 4

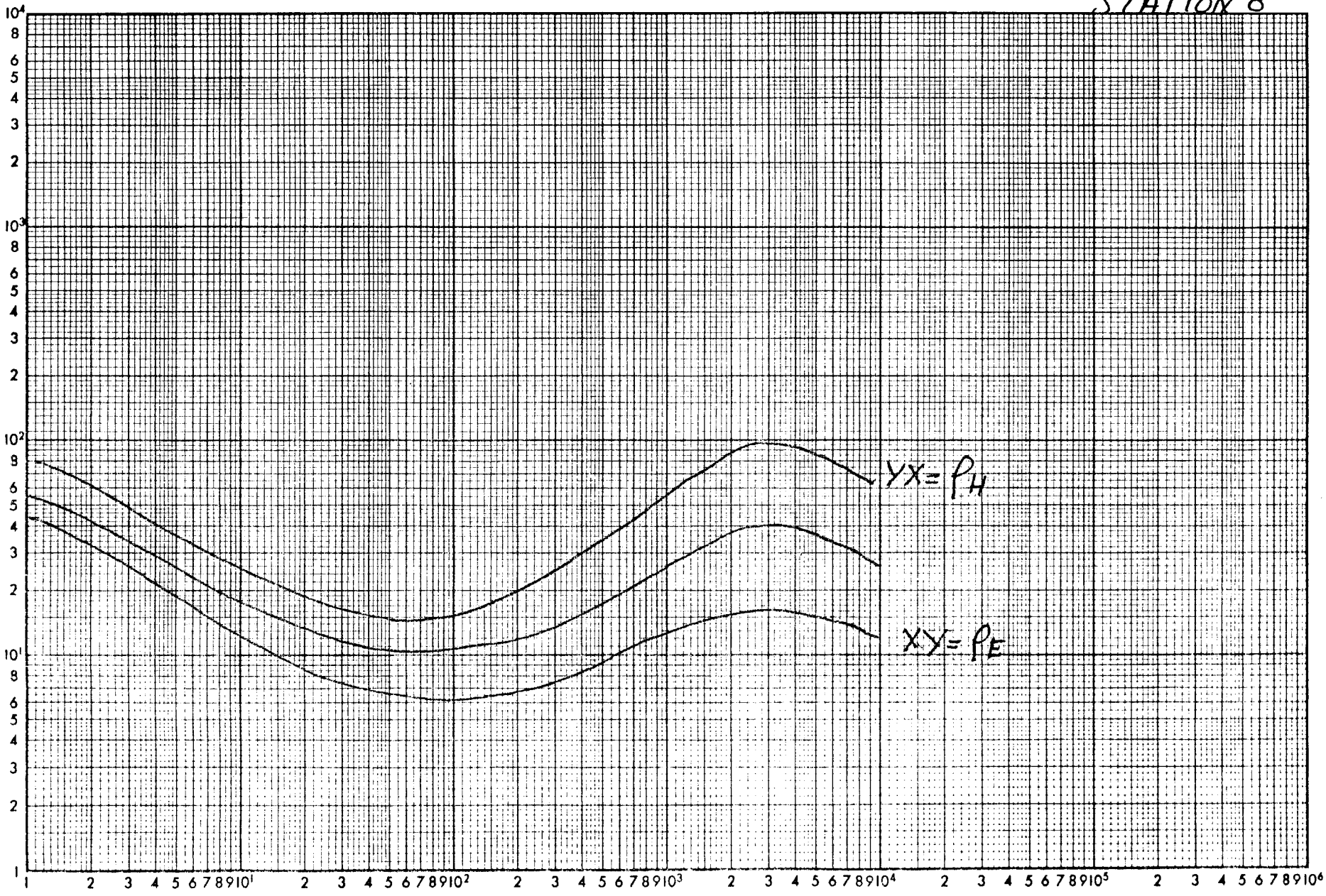
+

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 10kΩ | 275gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 10kΩ | 175gr | Ey | | | Hy |

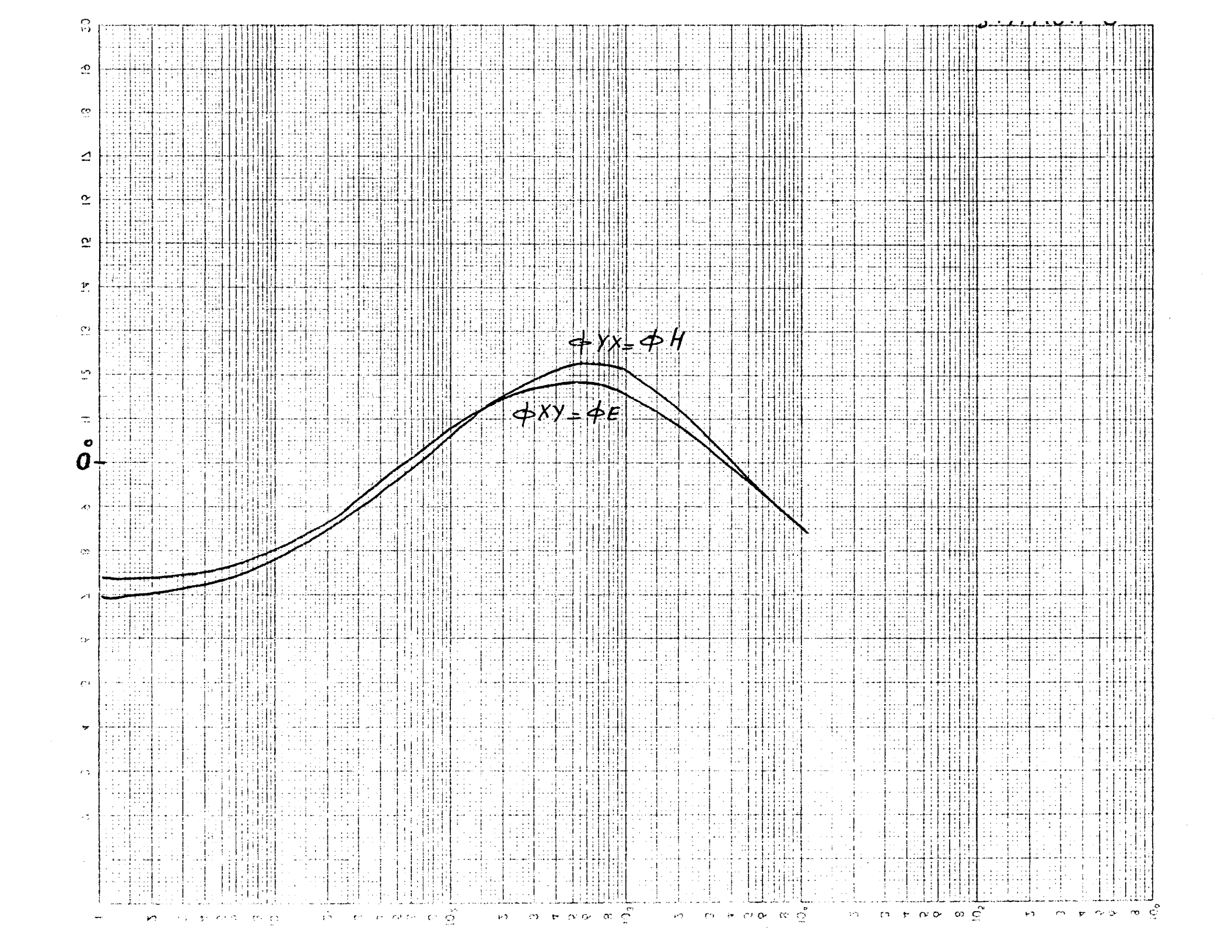
| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 59 | MF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 50x100 | | 7' | ⊗ |
| | | Sensibil. | 1 | 50mV/f | 1 | 50mV/f | 50mV/f | | | |
| 60 | HF | Gain | 50x100 | 20x30 | 50x100 | 20x30 | 50x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 61 | BF | Gain | 50x30 | 10x3 | 50x30 | 20x3 | 10x3 | | 72' | TRES FORT SIGNAL - DERIVE SUR Passage d'un camion pendant la TRAITER les 1ères 35mn, laissez les 2 et " les dernières 35mn |
| | | Sensibil. | " | " | " | " | " | | | |
| 62 | BF | Gain | 20x30 | 10x3 | 20x30 | 20x3 | 10x3 | | 75' | BON SIGNAL (Ne pas Traiter les 2 35mn) |
| | | Sensibil. | " | " | " | " | " | | | |
| 63 | MF | Gain | 50x100 | 50x30 | 50x100 | 50x30 | 50x100 | | | |
| | | Sensibil. | " | " | " | " | " | | | |
| 64 | HF | Gain | 50x100 | 50x30 | 50x100 | 50x30 | 50x100 | | | Très bruité |
| | | Sensibil. | | | | | | | | |

BROUILLARD - Pluie et Vent par passages intermittents

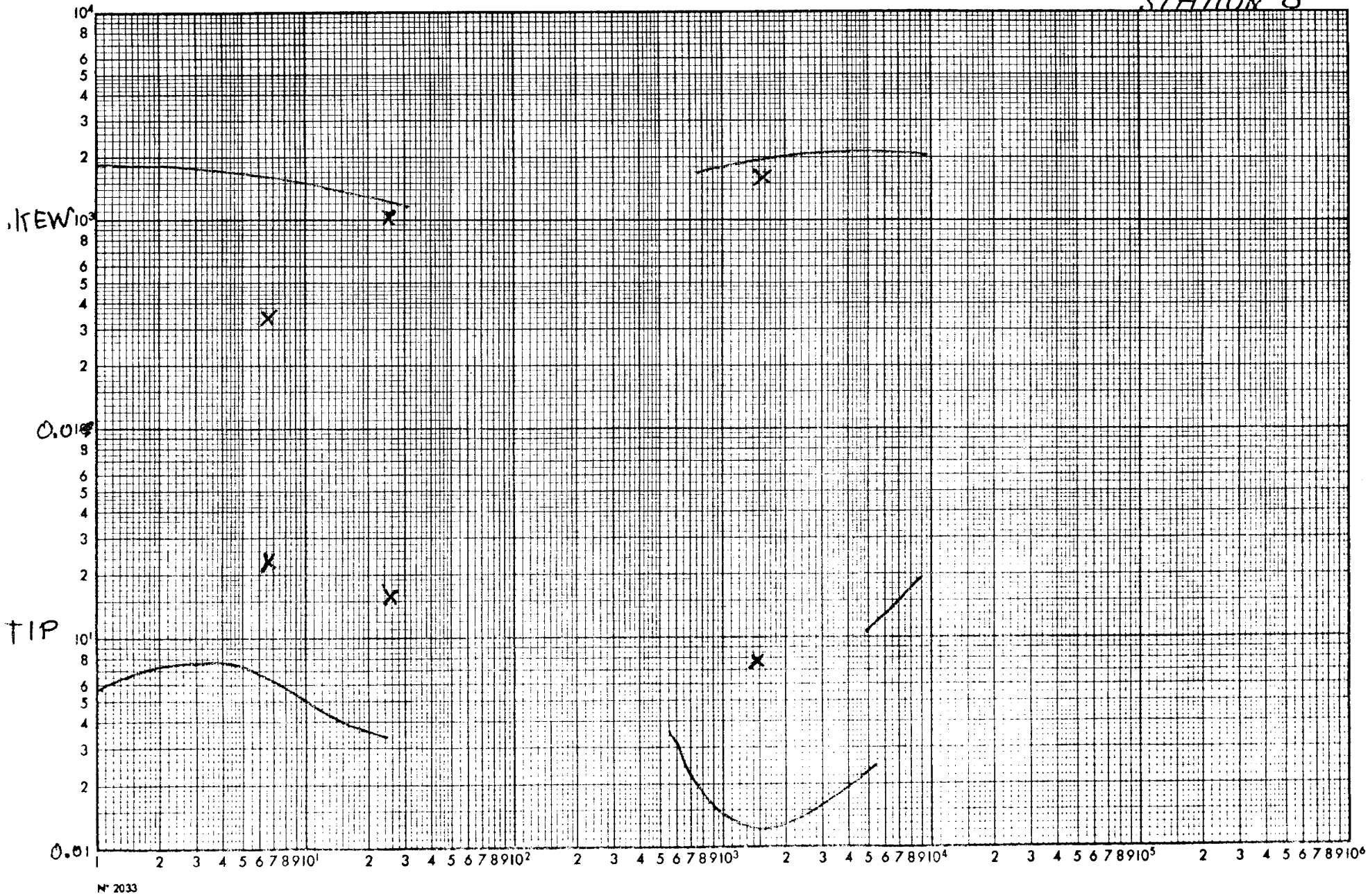
STATION 8




N° 2033


φYX = φH
φXY = φE
0°

STATION 8




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 15-10-82 | 404 25 11 | | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

Station : 8

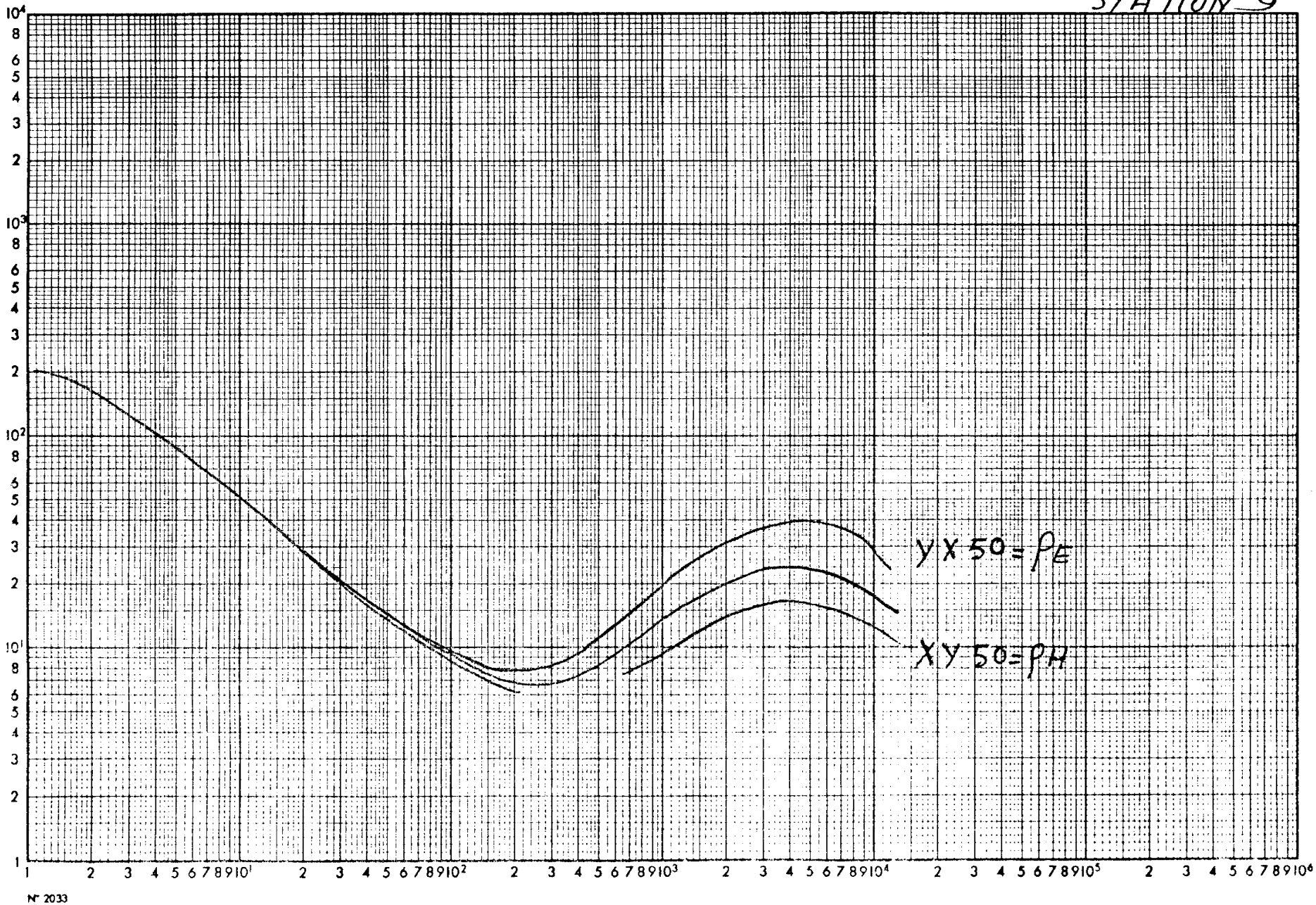
Tape : 1



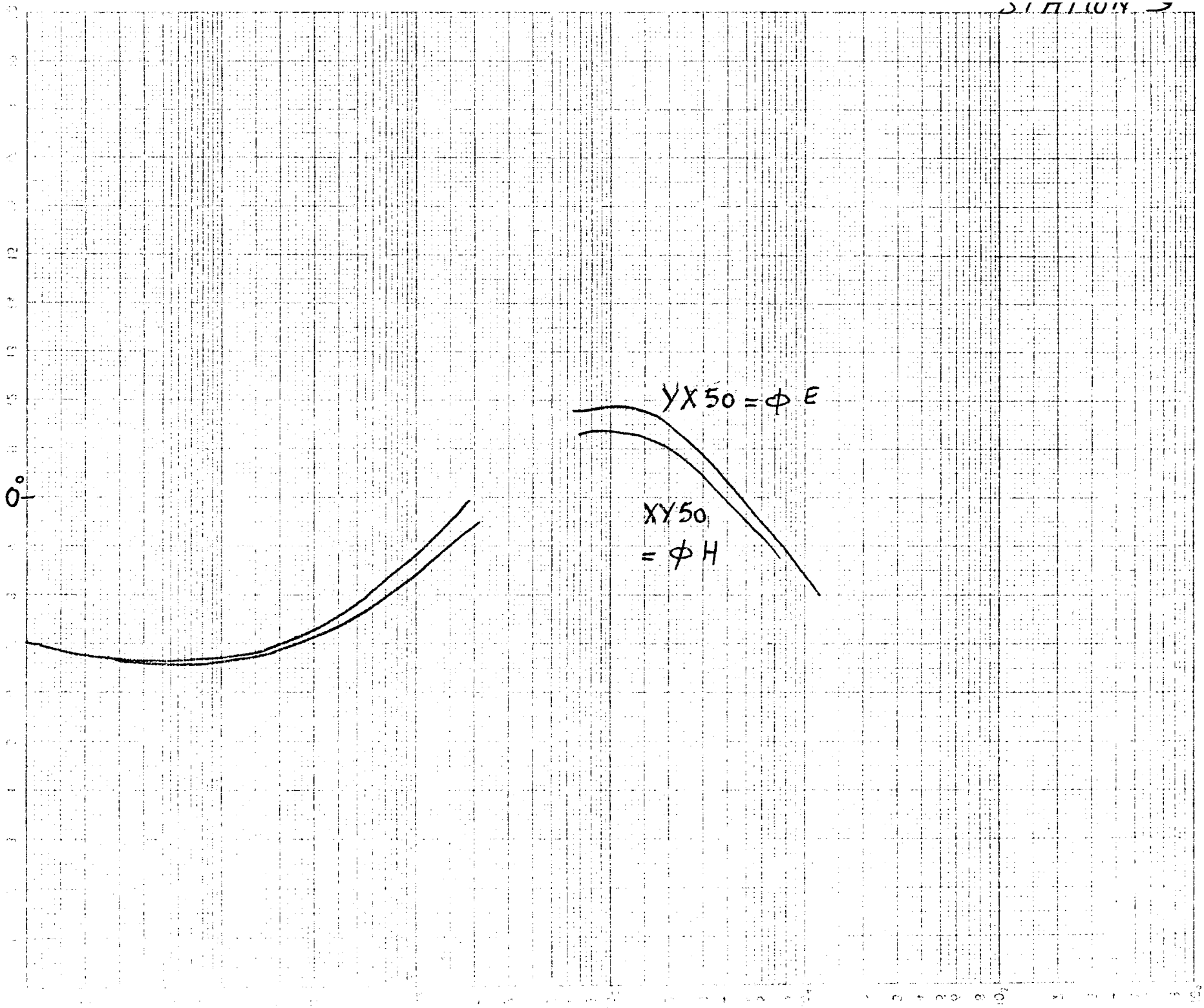

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 8 kΩ | 125 | Ex | | | Hx |
| Mag Number | . | 11 | | 5 | 9 | | 500' | 10 kΩ | | Ey | | | Hy |

| File | Domaine | | Channel 1 T1 | Channel 2 | Channel 3 T2 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 50 x 30 | | 7' | "Pets" → LP 100 Hz ON |
| | | Sensibil. | 1 | 50 mV/δ | 1 | 50 mV/δ | 50 mV/δ | | | |
| 13 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 50 x 30 | | 1' | LP 100 Hz OFF |
| | | Sensibil. | " | " | " | " | " | | | |
| 14 | BF | Gain | 50 x 30 | 20 x 1 | 50 x 30 | 20 x 1 | 10 x 3 | | 107' | LP 100 Hz ON |
| | | Sensibil. | " | " | " | " | " | | | |
| 15 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 50 x 30 | | 7' | LP 100 Hz OFF |
| | | Sensibil. | " | " | " | " | " | | | |
| 16 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 50 x 30 | | 1' | LP 100 Hz OFF |
| | | Sensibil. | " | " | " | " | " | | | ST tres bonne entre les p d'orage en MF. |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | |

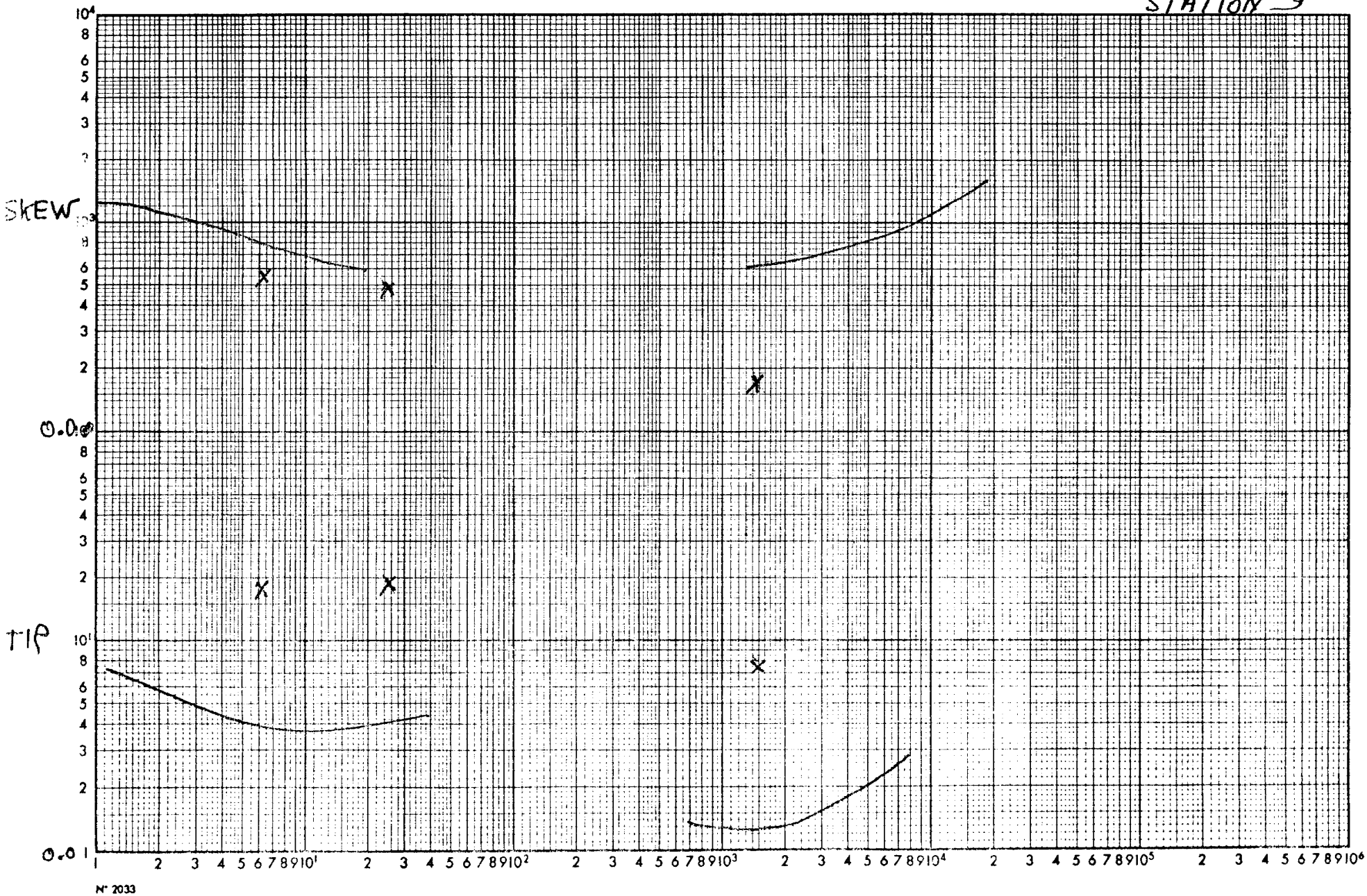
STATION 9




Nº 2033


0°
YX50 = φ E
XY50
= φ H

STATION 9




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RADULT | 17-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURI REPORT

Processing :

Sketch :

N

• Ey = 445'

Station : 9

Tape : 2

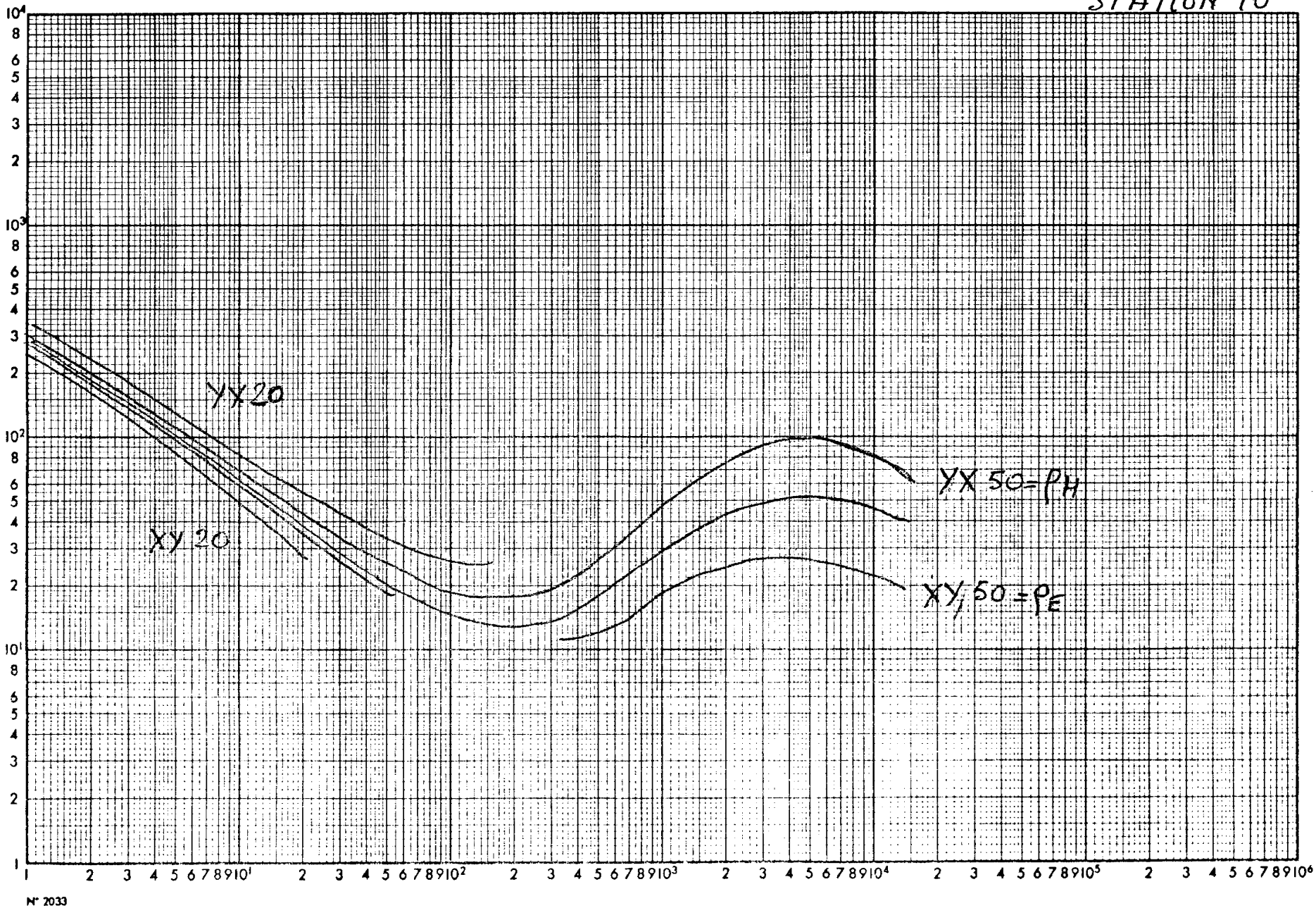
+

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | EX | Hy | Ey | HX | HZ | | 500' | 19 kΩ | 130 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 445' | 20 kΩ | 30 gr | Ey | | | Hy |

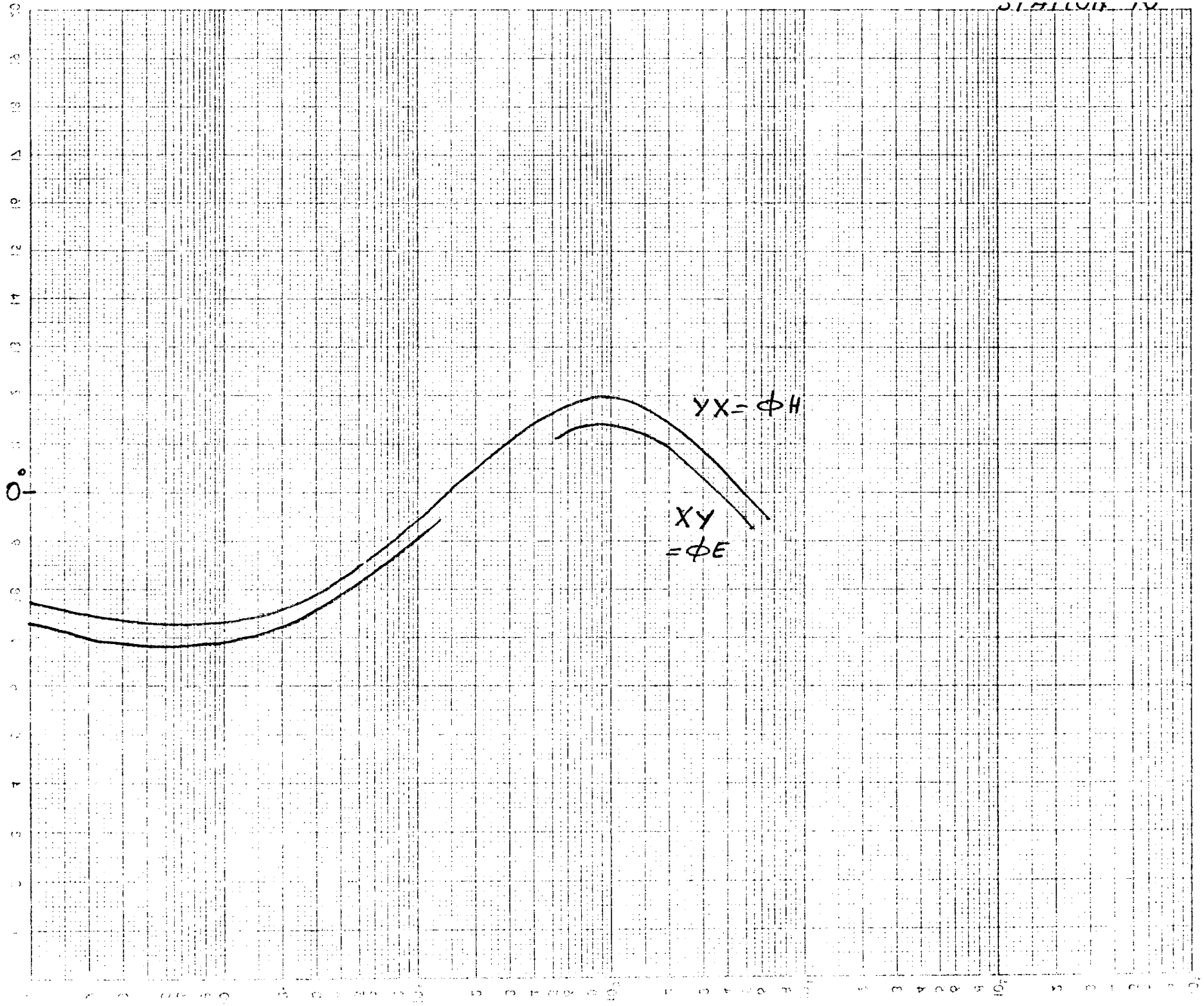
| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 22 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 7' | quelques "pets" d'orage. ⊗ |
| | | Sensibil. | 1 | 50 mV/γ | 1 | 50 mV/γ | 50 mV/γ | | | |
| 23 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| * 64 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 50 x 1 | | 107' | Beaucoup de "pets" d'orage surtout Ey. Un peu moins sur les 3° |
| | | Sensibil. | " | " | " | " | " | | | |
| 25 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 7' | Quelques "pets" d'orage aussi. |
| | | Sensibil. | " | " | " | " | " | | | |
| 26 | BF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 1' | * ATTENTION. Problème au n du Fichier BF. J'ai écrit 24 ... la lecture on trouve 64 (voir ... |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Ciel bleu. Vent leger |

⊗ En face des MF qui me semble les meilleures. Si pas très bon au traitement, Traiter les autres MF et Chois...

STATION 10

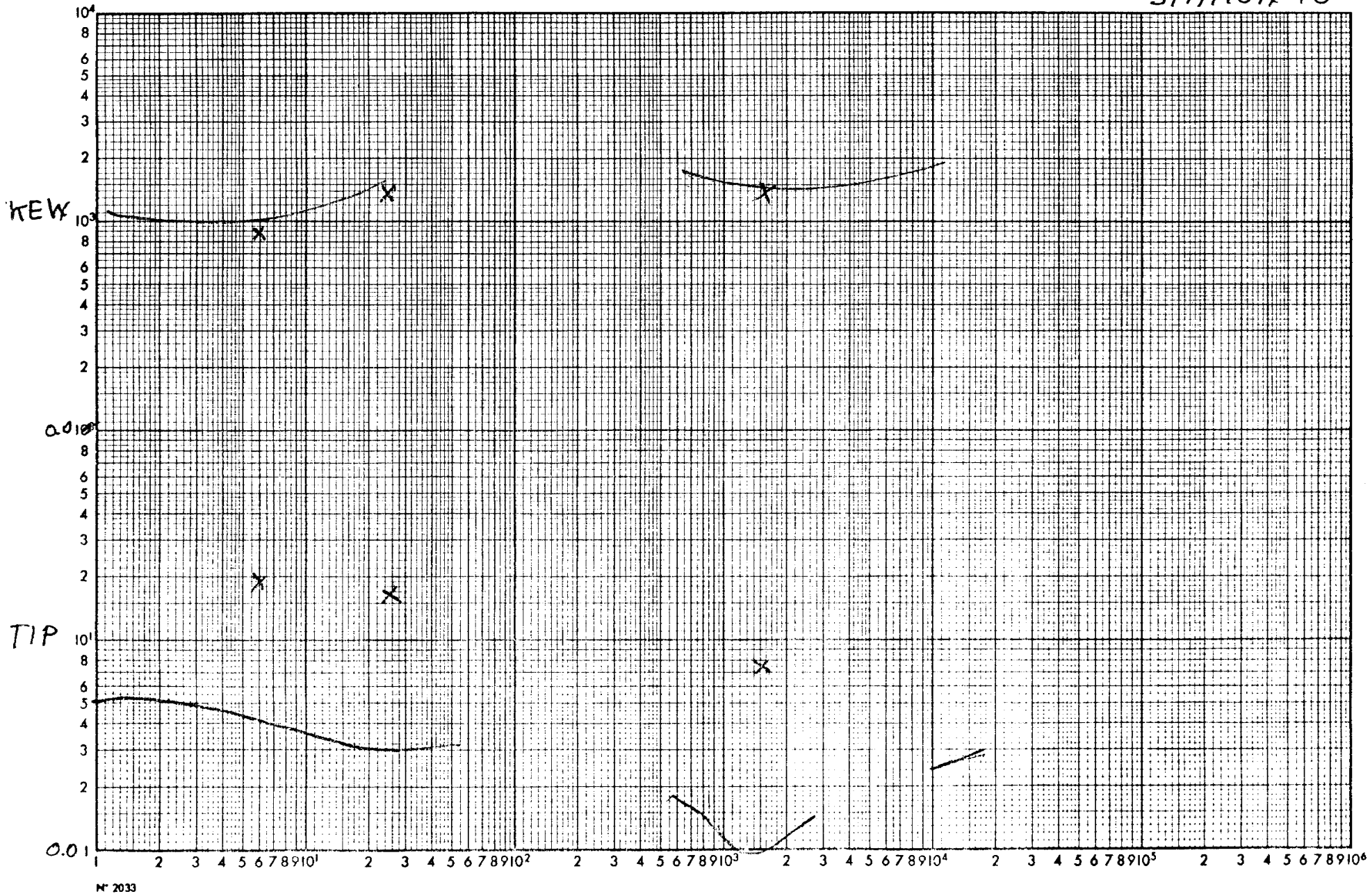



N° 2033



YX = ΦH
XY
= ΦE
0°

STATION 10




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 17.10.82 | 404.25.11 | GLASS MT | UNION |

# MAGNETOTELLURI REPORT

Processing :

Sketch :

N

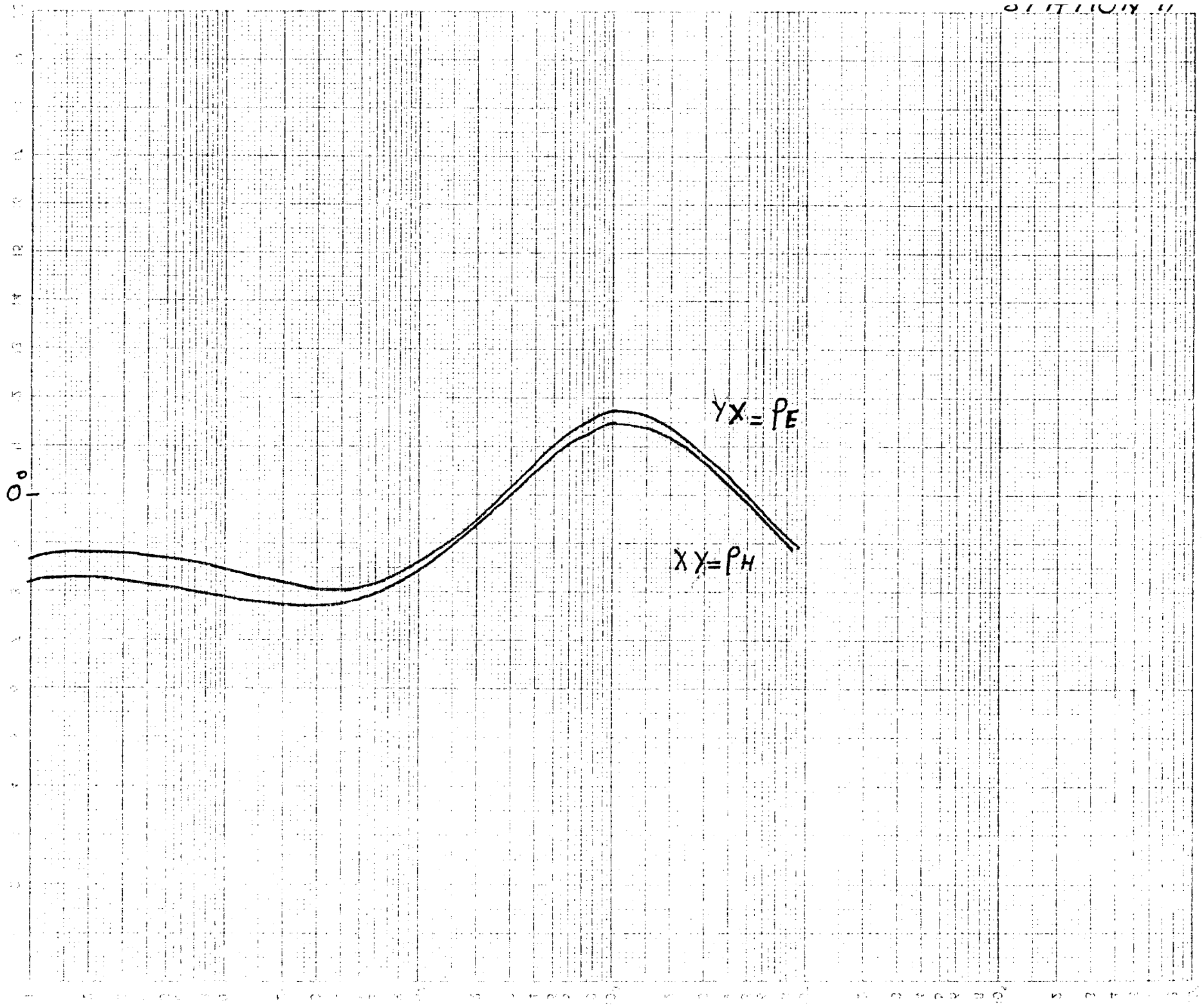
• Ey = 480'

Station : 10

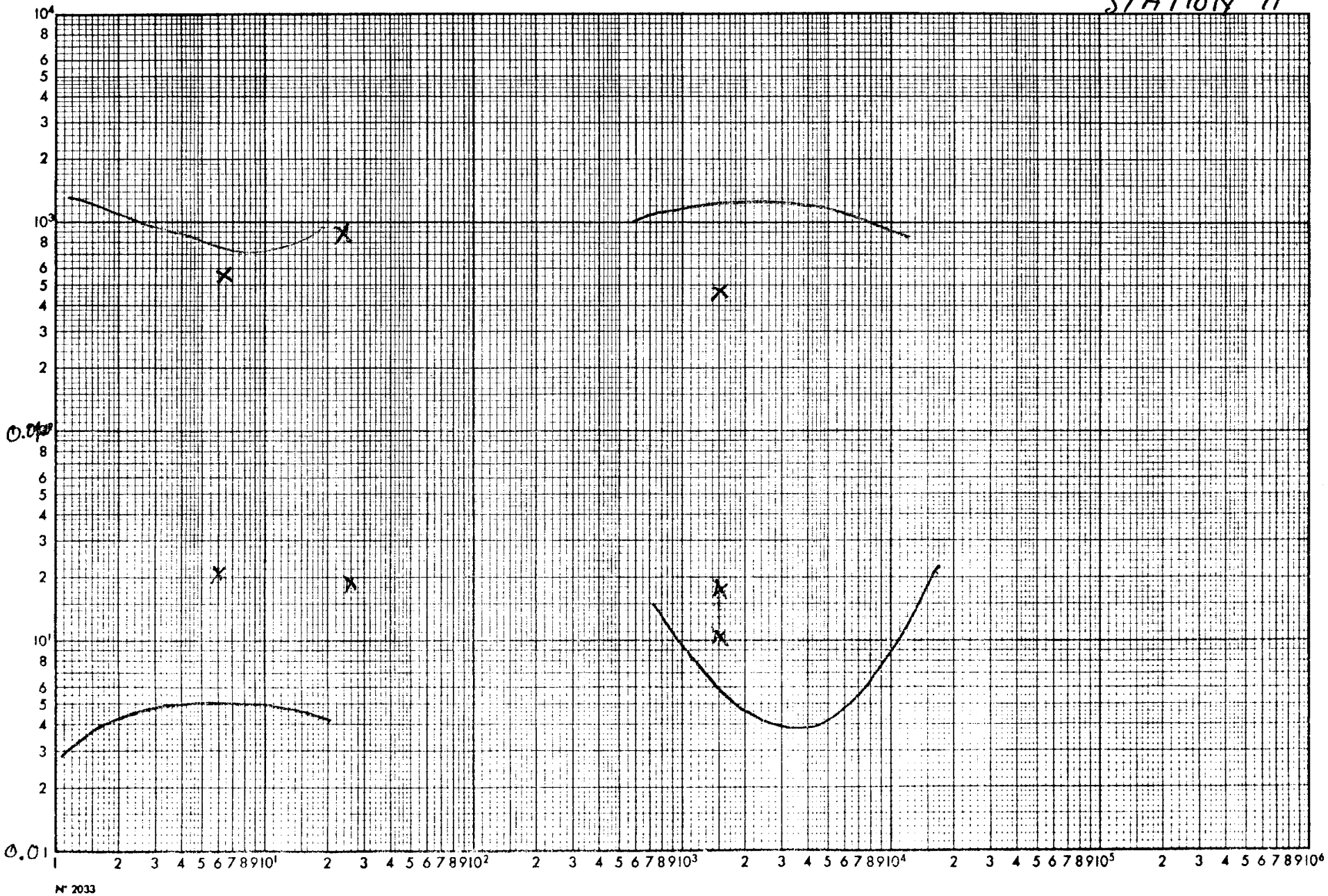
Tape : 2

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | E X | H y | E y | H X | H z | | 500' | 14 kΩ | 330 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | •480' | 17 kΩ | 230 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 27 | MF | Gain | 10 x 300 | 20x 30 | 10x300 | 20x 30 | 50x30 | | 7' | BON SIGNAL ⊗ |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | | | |
| 28 | HF | Gain | 10x300 | 20x30 | 10x300 | 20x 30 | 50x30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 29 | BF | Gain | 10x100 | 10x3 | 10x100 | 10x3 | 10x3 | | 707' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | |
| 30 | MF | Gain | 20x300 | 20x30 | 20x300 | 20x30 | 50x30 | | 7' | PROBLEME SUR HZ (pot Regulier Leger bruit sur Hy (vent leger f bouger les cables, qui font b le sol qui fait bouger les Mag. |
| | | Sensibil. | " | " | " | " | " | | | |
| 31 | HF | Gain | 20x300 | 20x30 | 20x300 | 20x30 | 50x30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Ciel bleu - Vent léger |


0°
YX = ρE
XY = ρH

STATION 11




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 14.10.82 | 404 25 11 | | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

Station : 11

Tape : 1




| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | | 40 kΩ | 25gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | | 40kΩ | 325gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 4 | MF | Gain | 50x300 | 20x30 | 50x300 | 20x30 | 20x30 | | 7' |
| | | Sensibil. | 1 | 50mV/8 | 1 | 50mV/8 | 50mV/8 | | |
| 5 | HF | Gain | 50x300 | 20x30 | 50x300 | 20x30 | 20x30 | | 11' |
| | | Sensibil. | " | " | " | " | " | | |
| 6 | BF | Gain | 50x30 | 20x3 | 50x30 | 20x3 | 20x3 | | 35' |
| | | Sensibil. | " | " | " | " | " | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

Résistances de prise de terre élevées. Signal Tell bruité.

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 15-10-82 | 404 25 11 | | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

Station : 11 Reprise

Tape : 1

| | 0 | 1 | 2 | 3 | 4 | 5 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel | 1 | 2 | 3 | 4 | 5 | 6 | | | | | | | |
| Sensor | Ex | Hy | Ey | Hx | Hz | Ex | 500' | 20 kΩ | 25 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 500' | 20 kΩ | 325 gr | Ey | | | Hy |

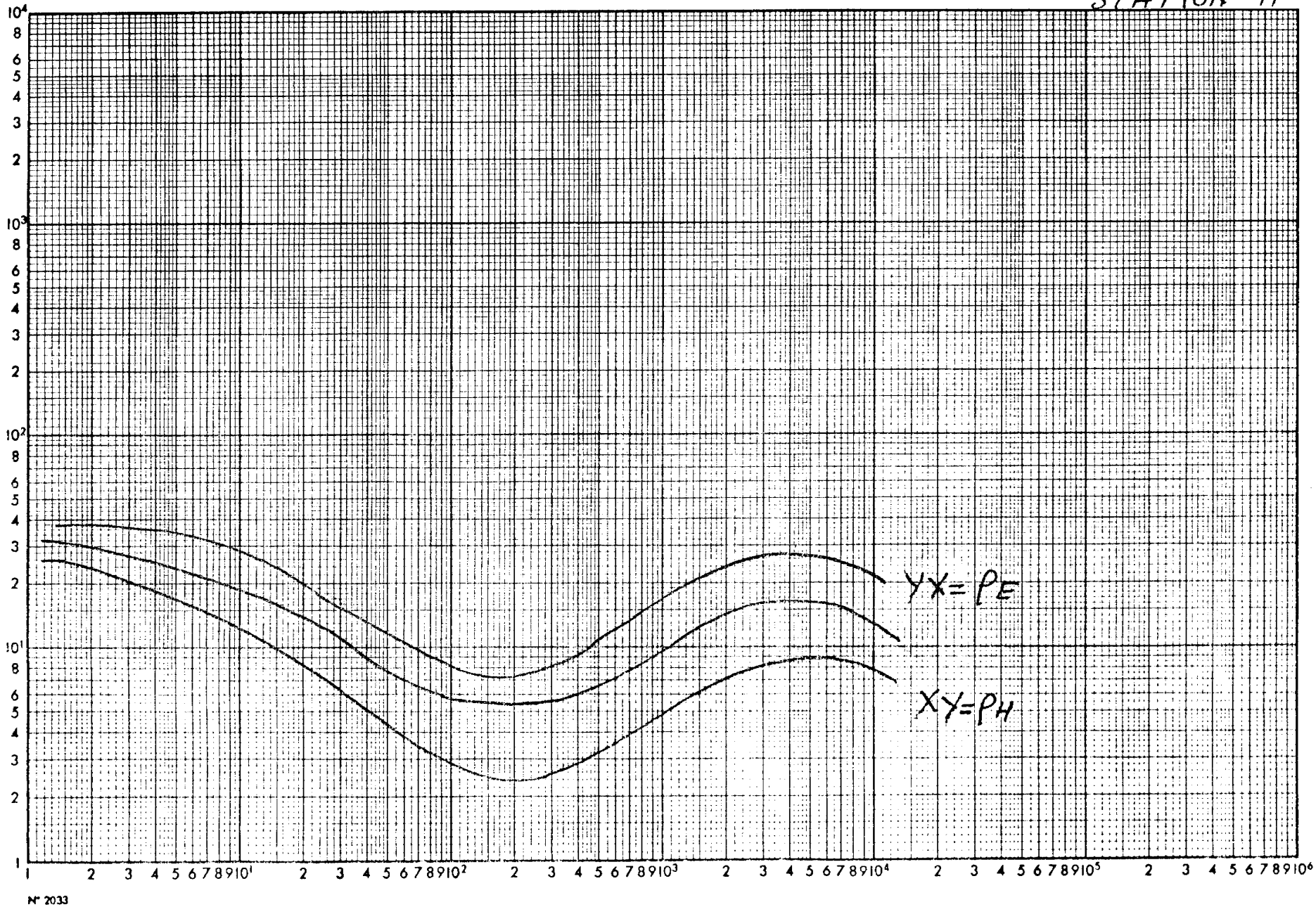
| File | Domaine | | Channel 1 ($T_1$) | Channel 2 | Channel 3 ($T_2$) | Channel 4 | Channel 5 | Channel 6 | Time |
|---|---|---|---|---|---|---|---|---|---|
| 7 | MF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 20 x 30 | 20 x 300 | 7' |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | 1 | |
| 8 | HF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 20 x 30 | 20 x 300 | 1' |
| | | Sensibil. | " | " | " | " | " | " | |
| 9 | BF | Gain | 20 x 100 | 10 x 3 | 20 x 100 | 10 x 3 | 10 x 3 | 20 x 100 | 107' |
| | | Sensibil. | " | " | " | " | " | " | |
| 10 | MF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 20 x 30 | 20 x 300 | 7' |
| | | Sensibil. | " | " | " | " | " | " | |
| 11 | HF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 20 x 30 | 20 x 300 | 1' |
| | | Sensibil. | " | " | " | " | " | " | |
| | | Gain | | | | | | | |
| | | Sensibil. | | | | | | | |

Remarks :

En Voie 6 : Ex para à Ex Voie 1, mais avec électrodes salées

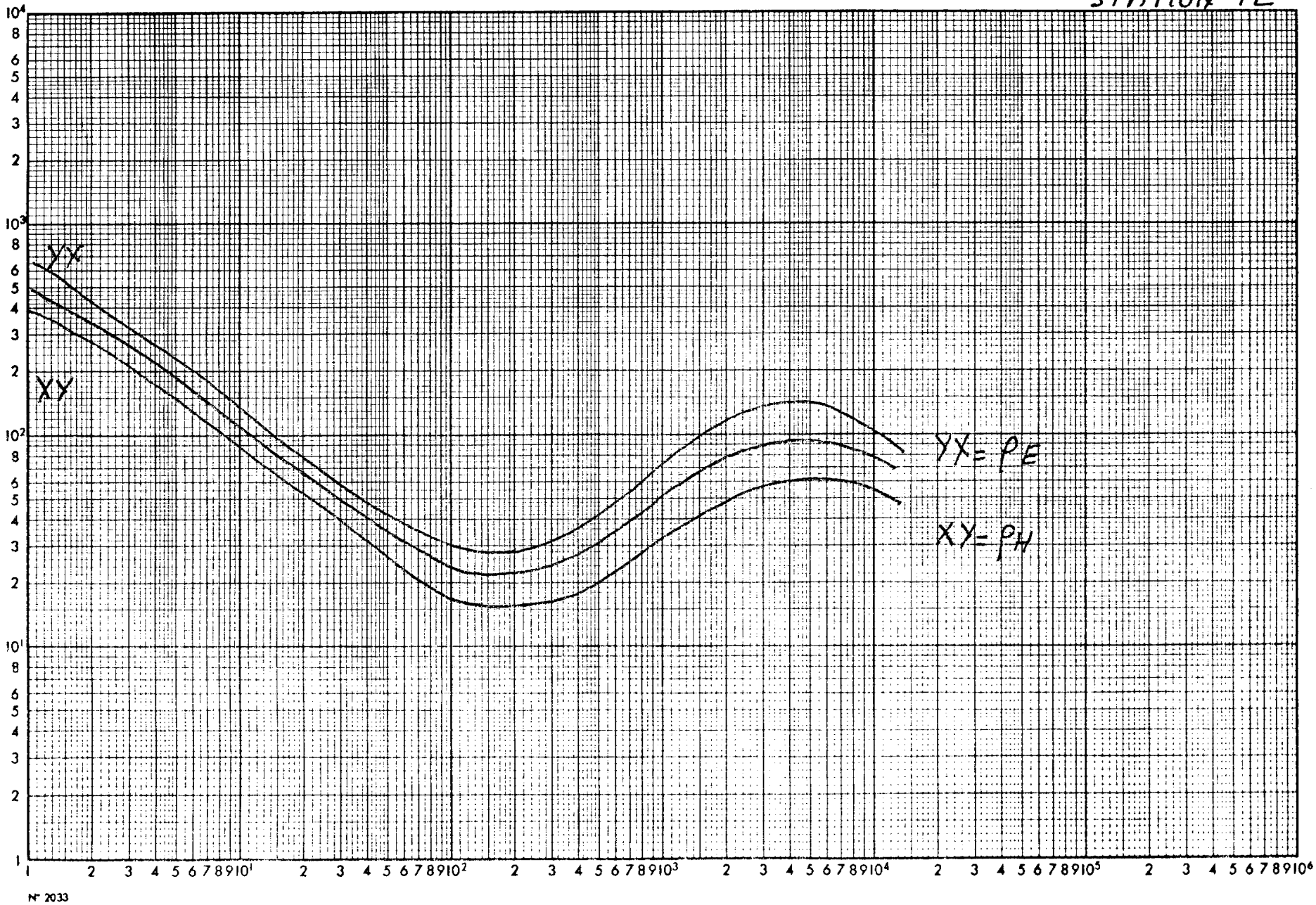
$R_{Ex\ Voie\ 6} = 12\ k\Omega$

STATION 11

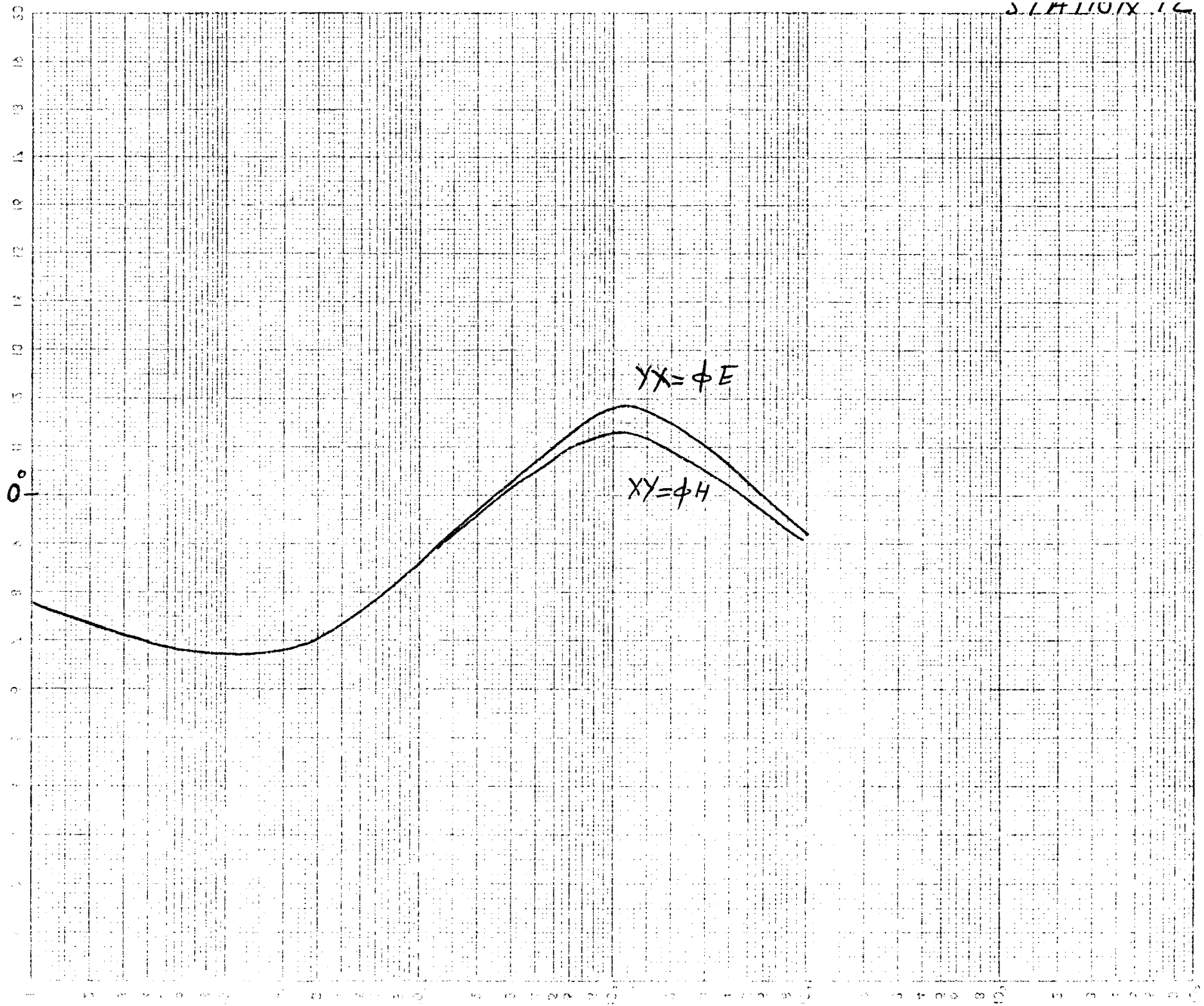



N° 2033

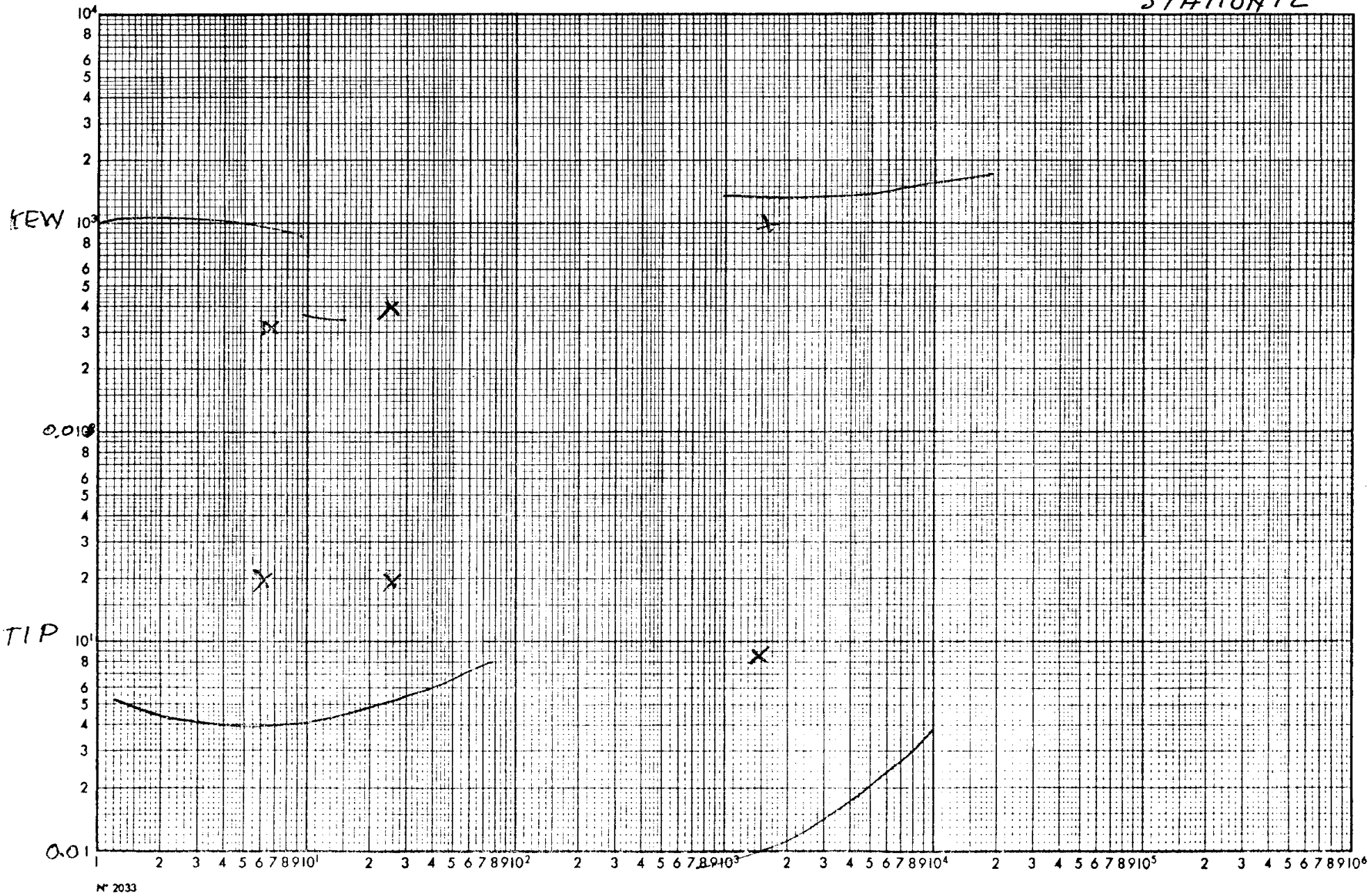
STATION 12




N° 2033


YX=ϕE
XY=ϕH
0°

STATION 12



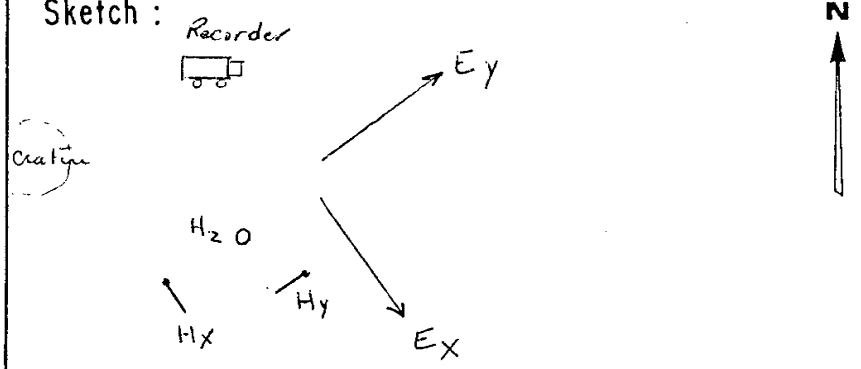

N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 16.10.82 | 404.25.11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :




Station : 12

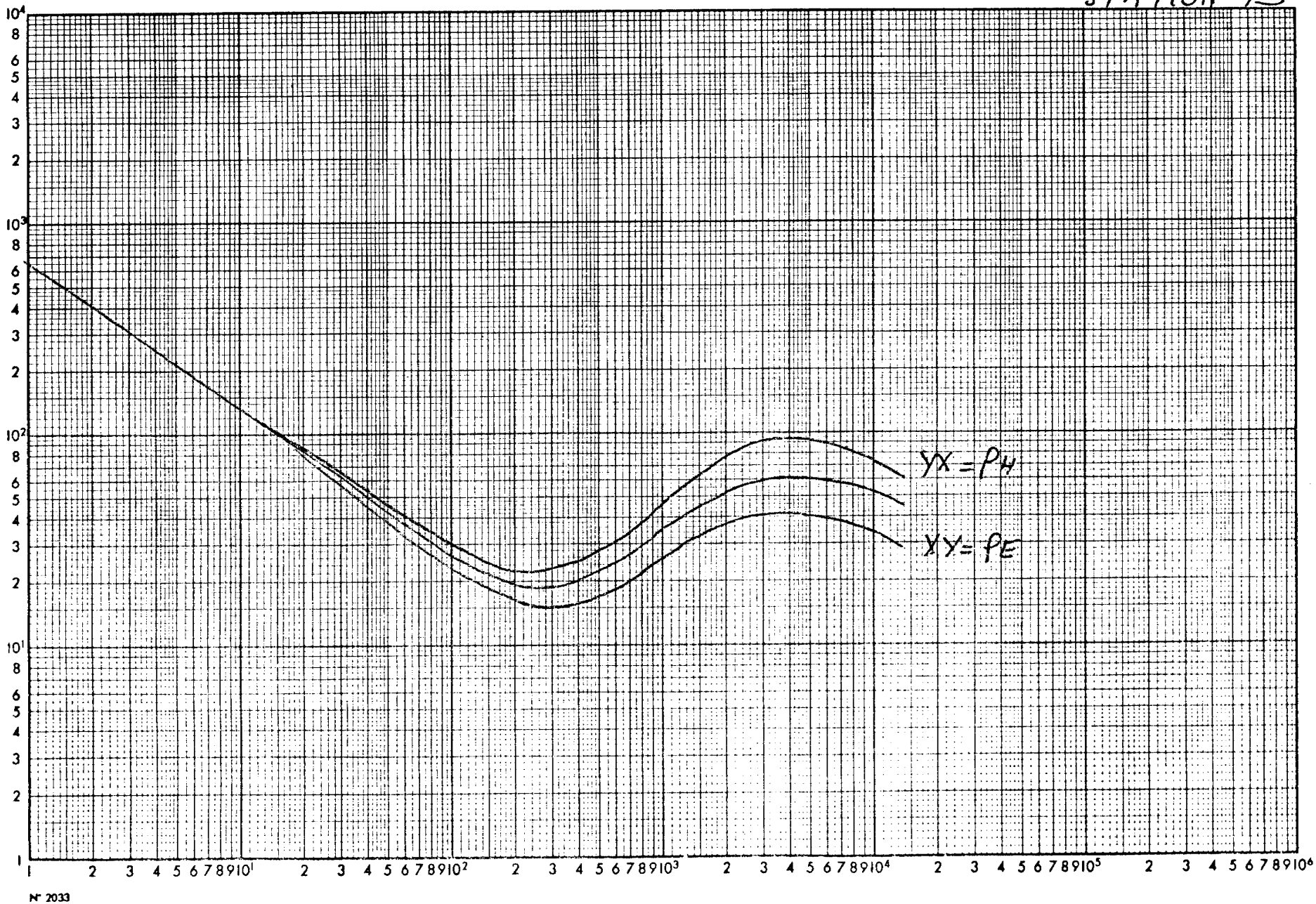
Tape : 1

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 20 kΩ | 160 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 9 | | 500' | 20 kΩ | 60 gr | Ey | | | Hy |

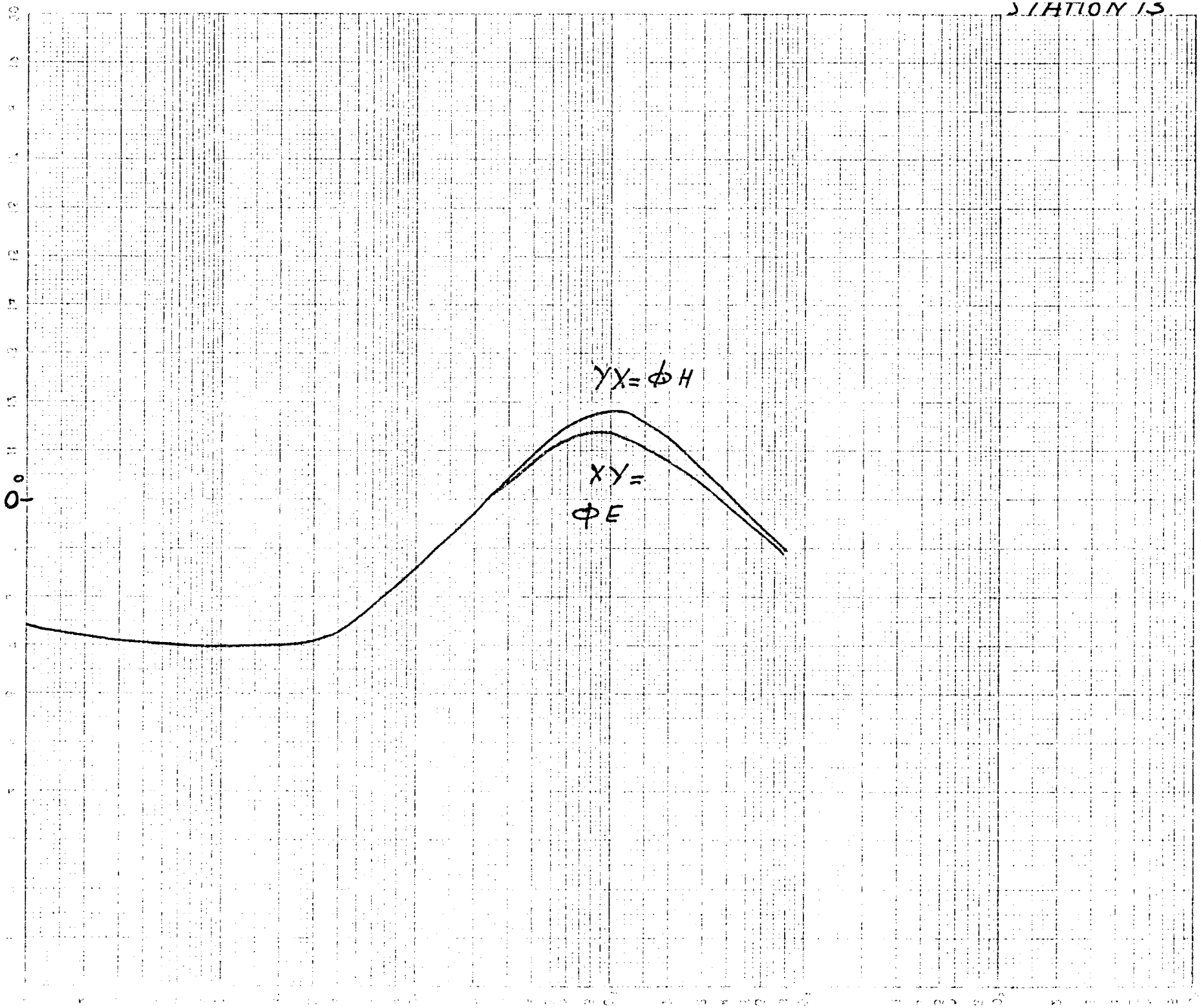
| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 7' | |
| | | Sensibil. | 1 | 50 mV/γ | 1 | 50 mV/γ | 50 mV/γ | | | |
| 18 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 50 x 30 | | 1' | |
| | | Sensibil. | i | i | i | i | i | | | |
| 19 | BF | Gain | 20 x 30 | 20 x 1 | 20 x 30 | 20 x 1 | 50 x 1 | | 107' | Pets d'orage (1 par mn environ |
| | | Sensibil. | | | | | | | | |
| 20 | MF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 50 x 30 | | 7' | |
| | | Sensibil. | i | i | i | i | i | | | |
| 21 | HF | Gain | 20 x 300 | 20 x 30 | 20 x 300 | 20 x 30 | 50 x 30 | | 1' | |
| | | Sensibil. | i | i | i | i | i | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | |

E.N.D.T. FIN de BANDE 1

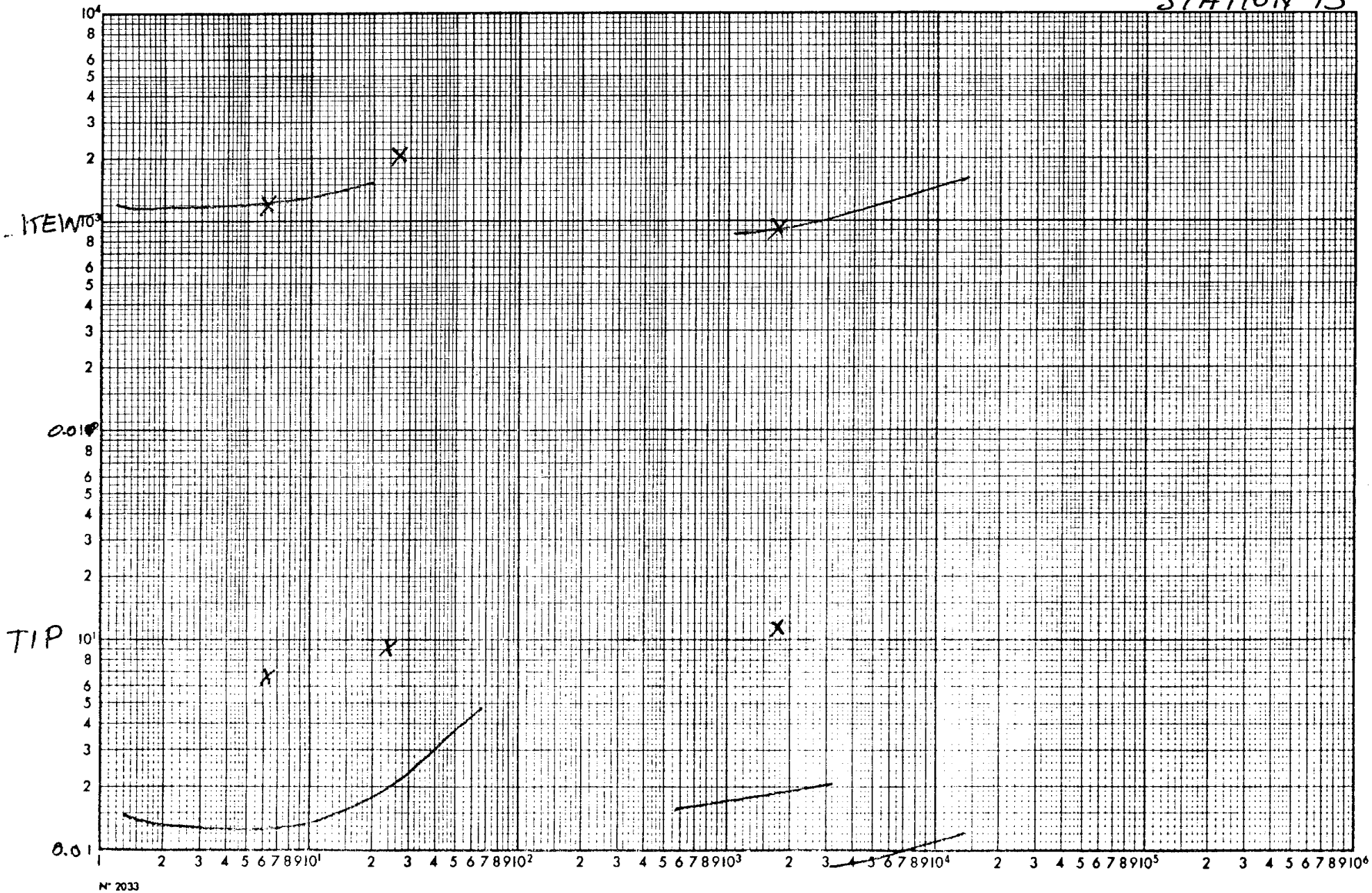
STATION 13




N° 2033


STATION 13
YX= ϕ H
XY=
ϕ E
0

STATION 13


ITEM
TIP
0.01
0.01
1 2 3 4 5 6 7 8 9 10¹ 2 3 4 5 6 7 8 9 10² 2 3 4 5 6 7 8 9 10³ 2 3 4 5 6 7 8 9 10⁴ 2 3 4 5 6 7 8 9 10⁵ 2 3 4 5 6 7 8 9 10⁶
N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 13-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

• Ey = 450'

Station : 13

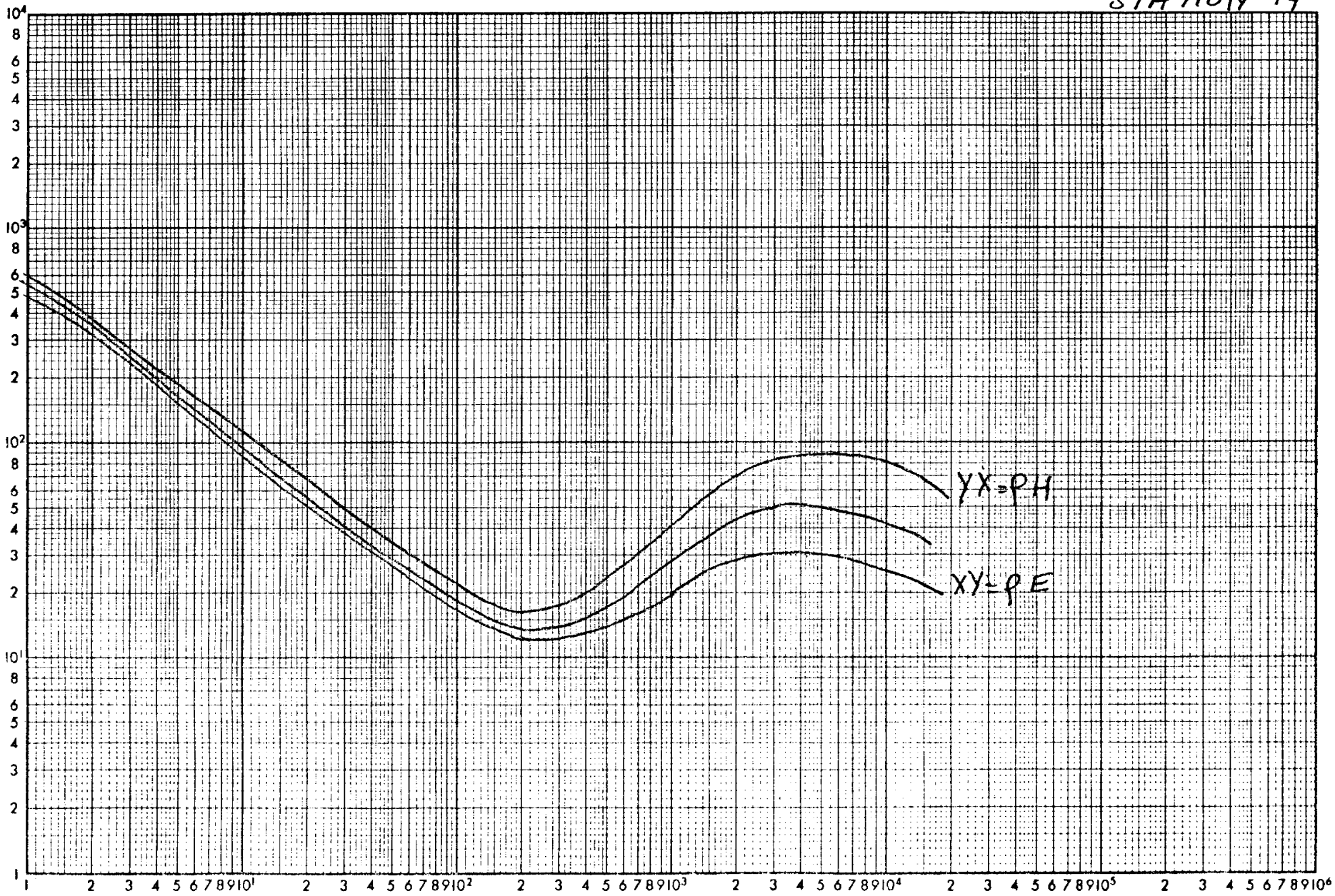
Tape : 3

+

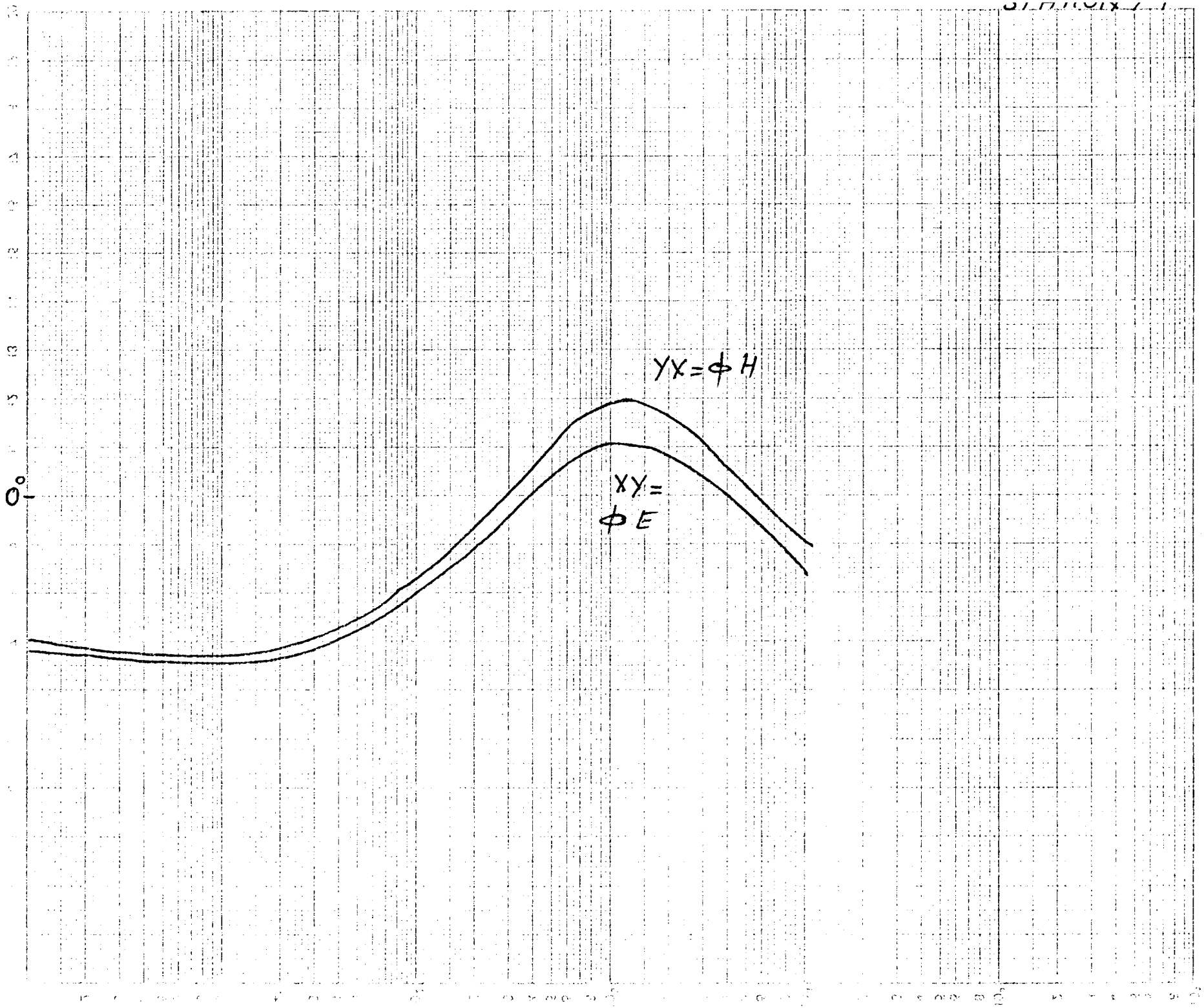
| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 9kΩ | 240gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 450' | 15kΩ | 140gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| L12 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 20 x 100 | | 7' | - perturbation sur Ex |
| | | Sensibil. | 1 | 50mV/F | 1 | 50mV/F | 50mV/F | | | |
| L13 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 20 x 100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| L14 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 20 x 3 | 10 x 3 | | 107' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | |
| L15 | MF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 20 x 100 | | 7' | MF. HF : o.k. ⊗ |
| | | Sensibil. | " | " | " | " | " | | | |
| L16 | HF | Gain | 20 x 100 | 20 x 30 | 20 x 100 | 20 x 30 | 20 x 100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | ciel couvert - pas de vent |

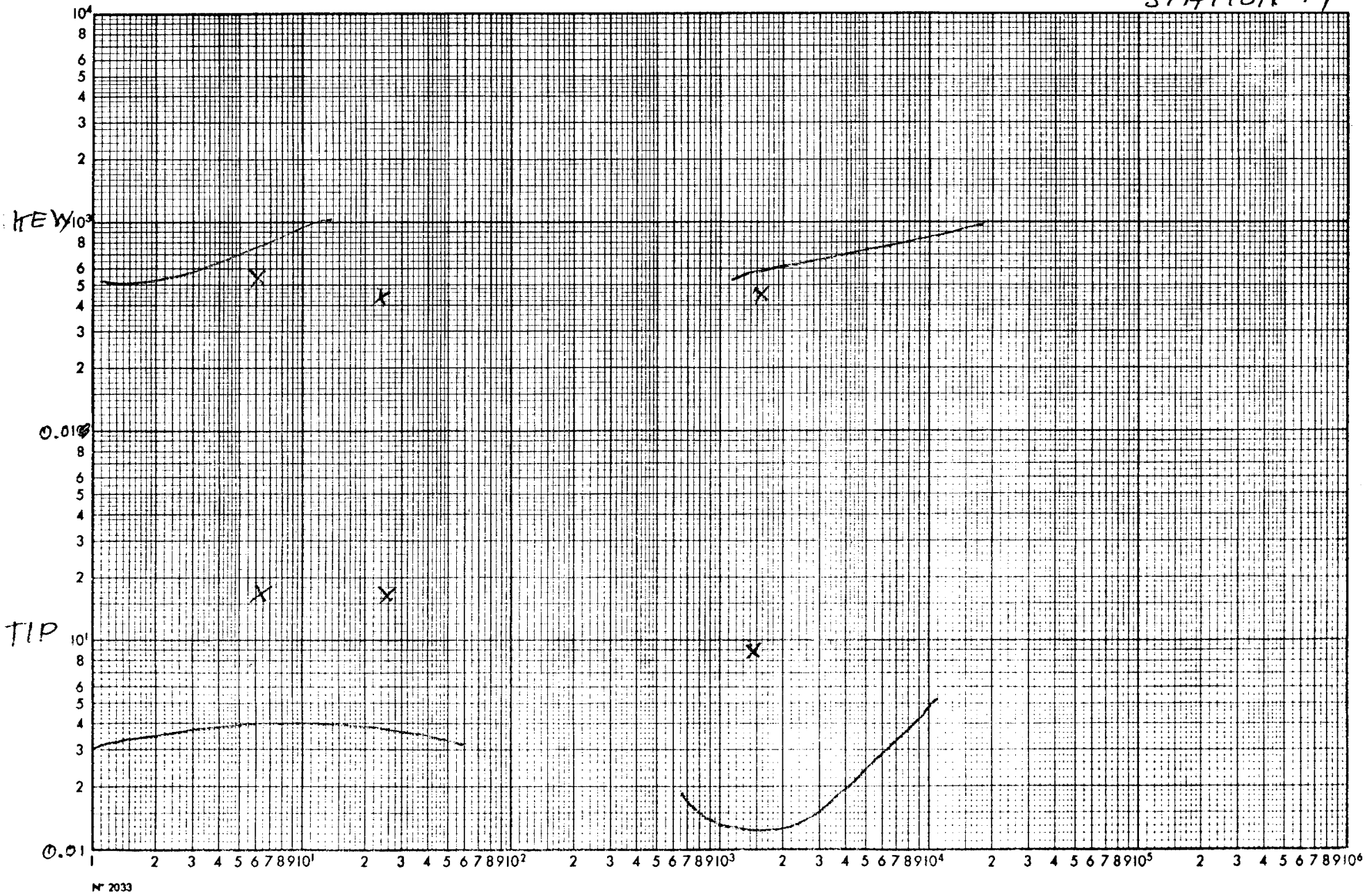
STATION 14




N° 2033


YX=ϕH
XY=
ϕE
0°

STATION 14




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 19-10-82 | 404.25.11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Station : 14

Tape : 2

Processing :

Sketch :

N

+

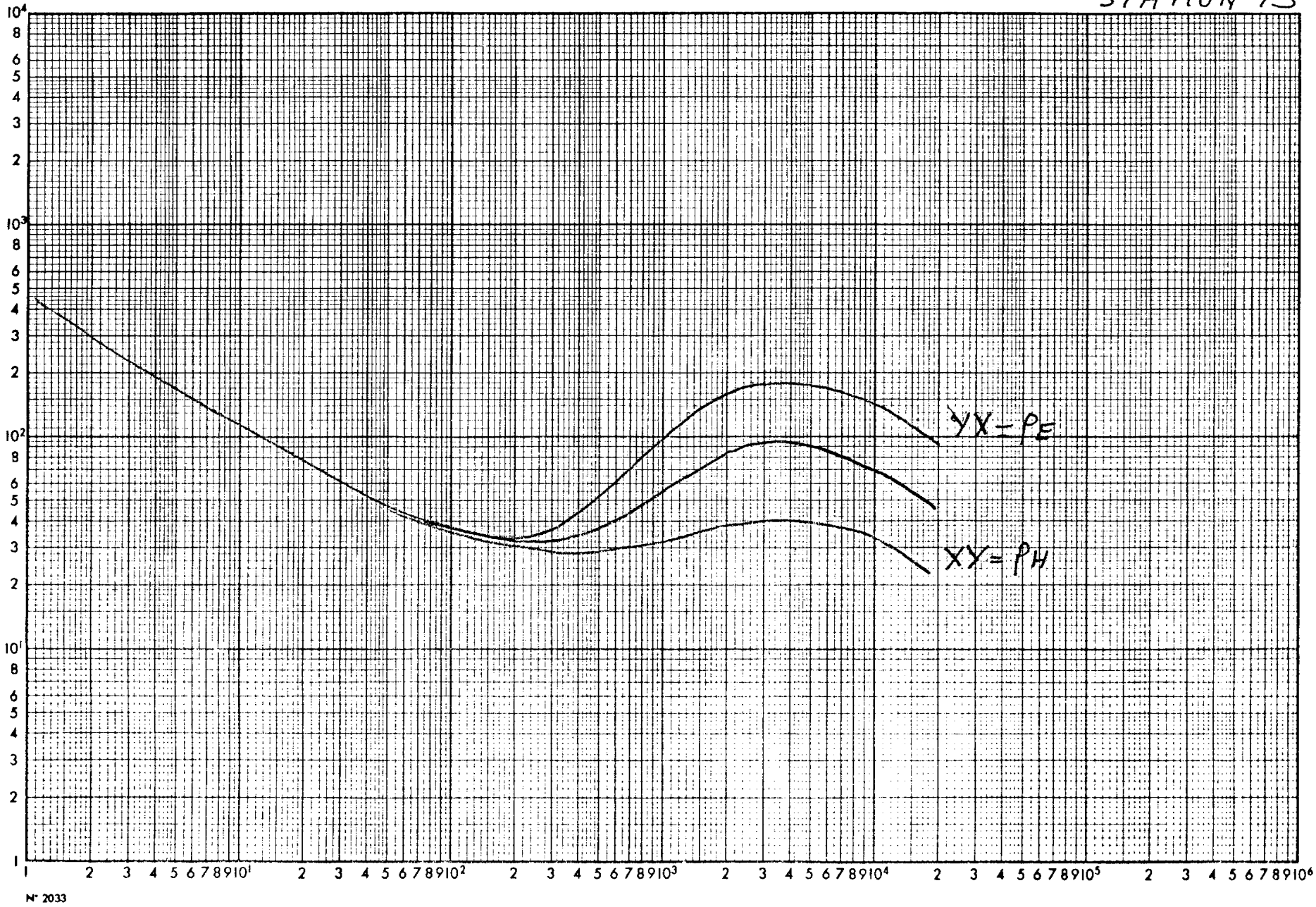
- Sur Ey : Denivelé de ± +25 m entre le centre et electrode lointaine.
- Hz = Mag CM10/16

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 9kΩ | 10gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 9kΩ | 310gr | Ey | | | Hy |

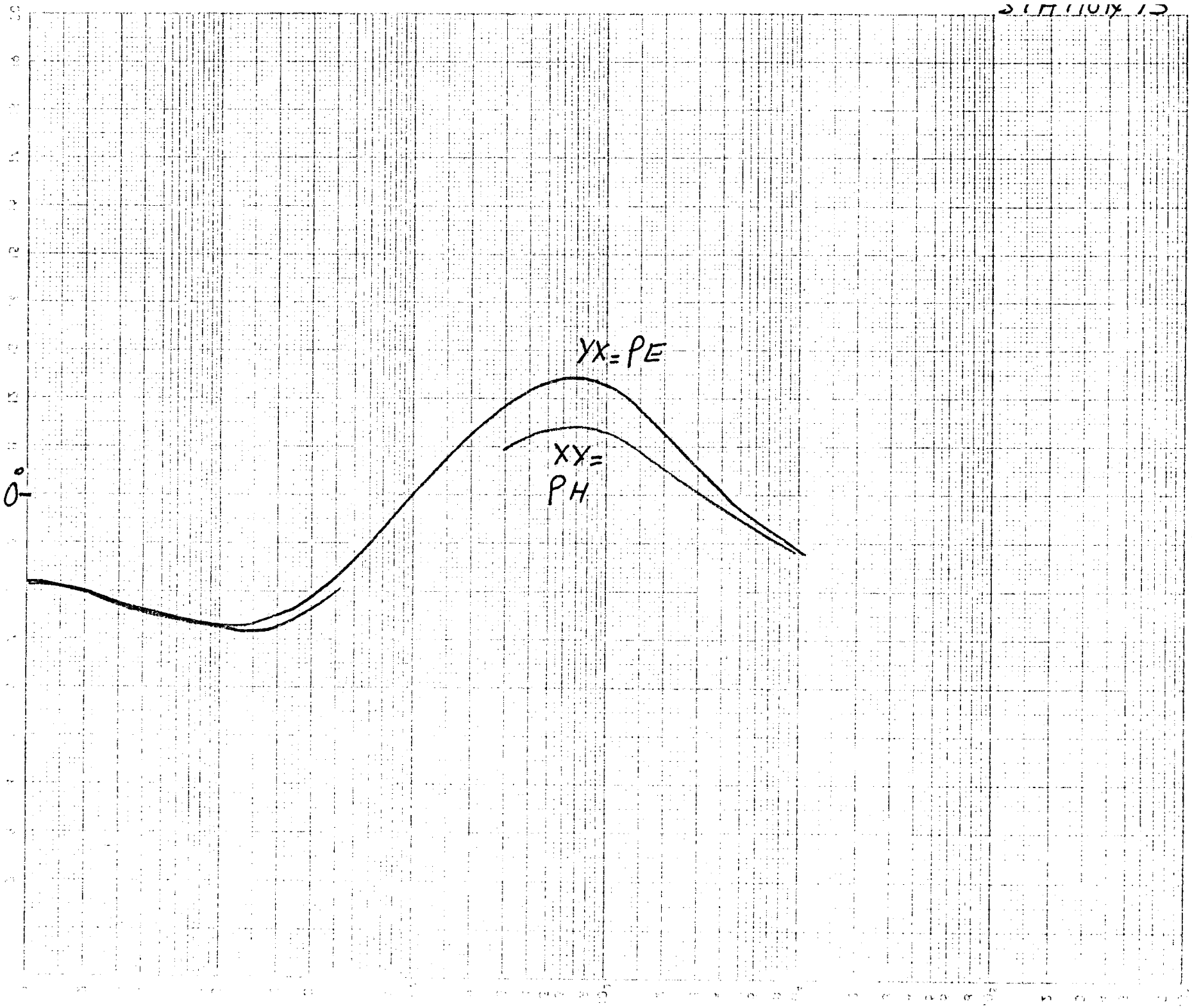
| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 37 | MF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 7' | ⊗ |
| | | Sensibil. | 1 | 50mV/δ | 1 | 50mV/δ | 50mV/δ | | | |
| 38 | HF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 39 | BF | Gain | 20x30 | 5x3 | 20x30 | 10x3 | 10x3 | | 107' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | | |
| 40 | MF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 7' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 41 | HF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 1'40" | |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Ciel couvert - Pas de Vent |

E.N.D.T FIN de BANDE 2

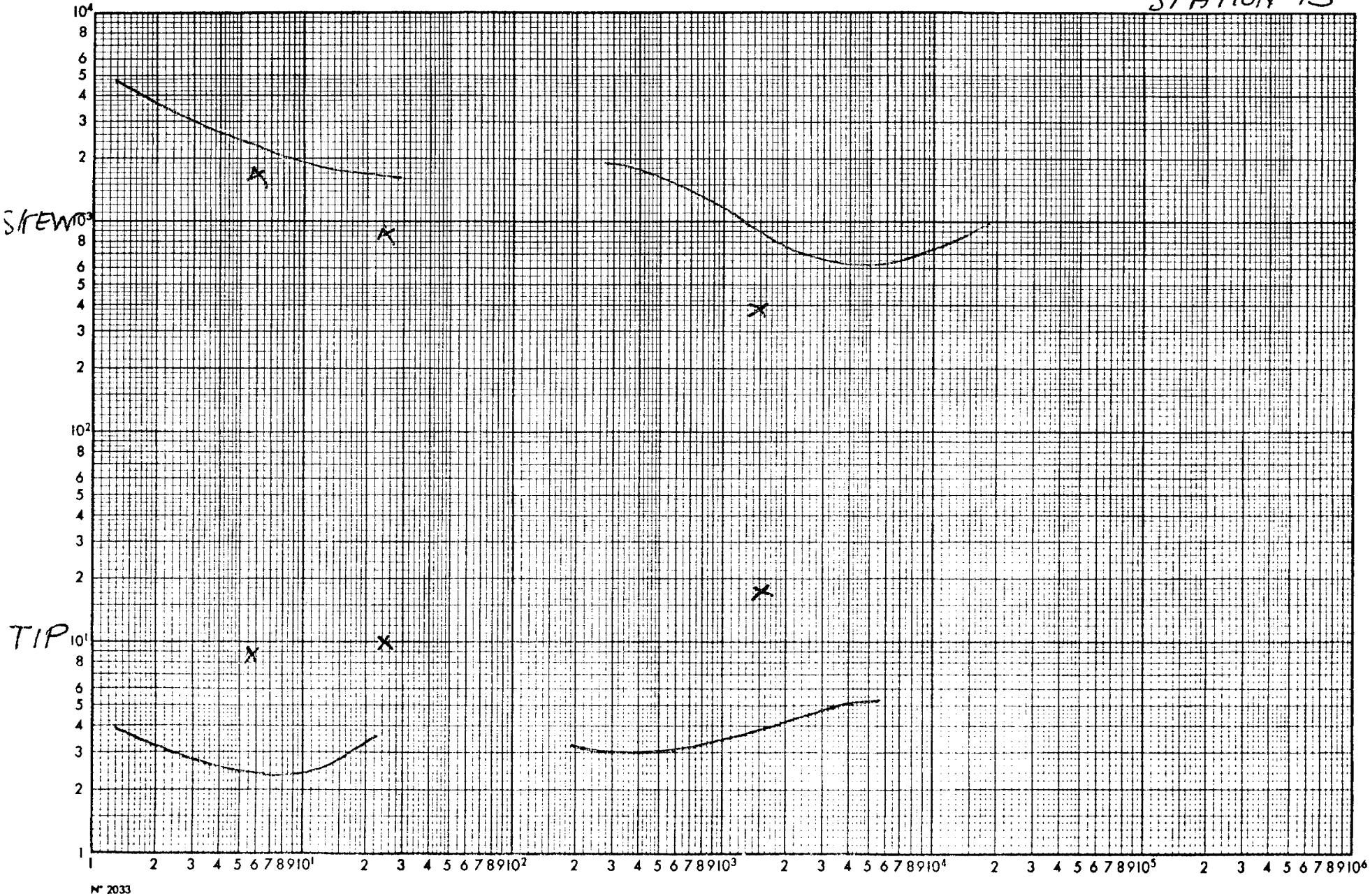
STATION 15




N° 2033


YX= ρE
XY= ρH
0°

STATION 15




N° 2033

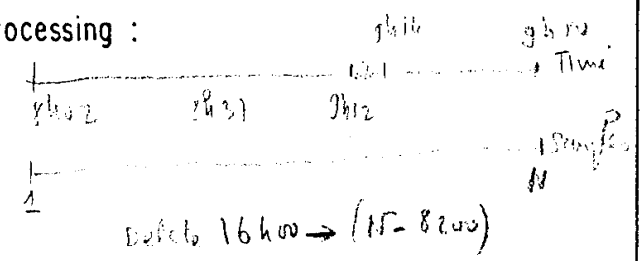
| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RADULT | 29-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLURI REPORT

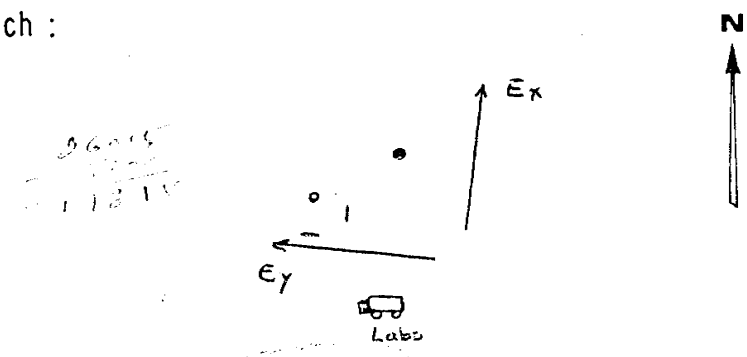
Station : 15

Tape : 5

Processing :




Sketch :



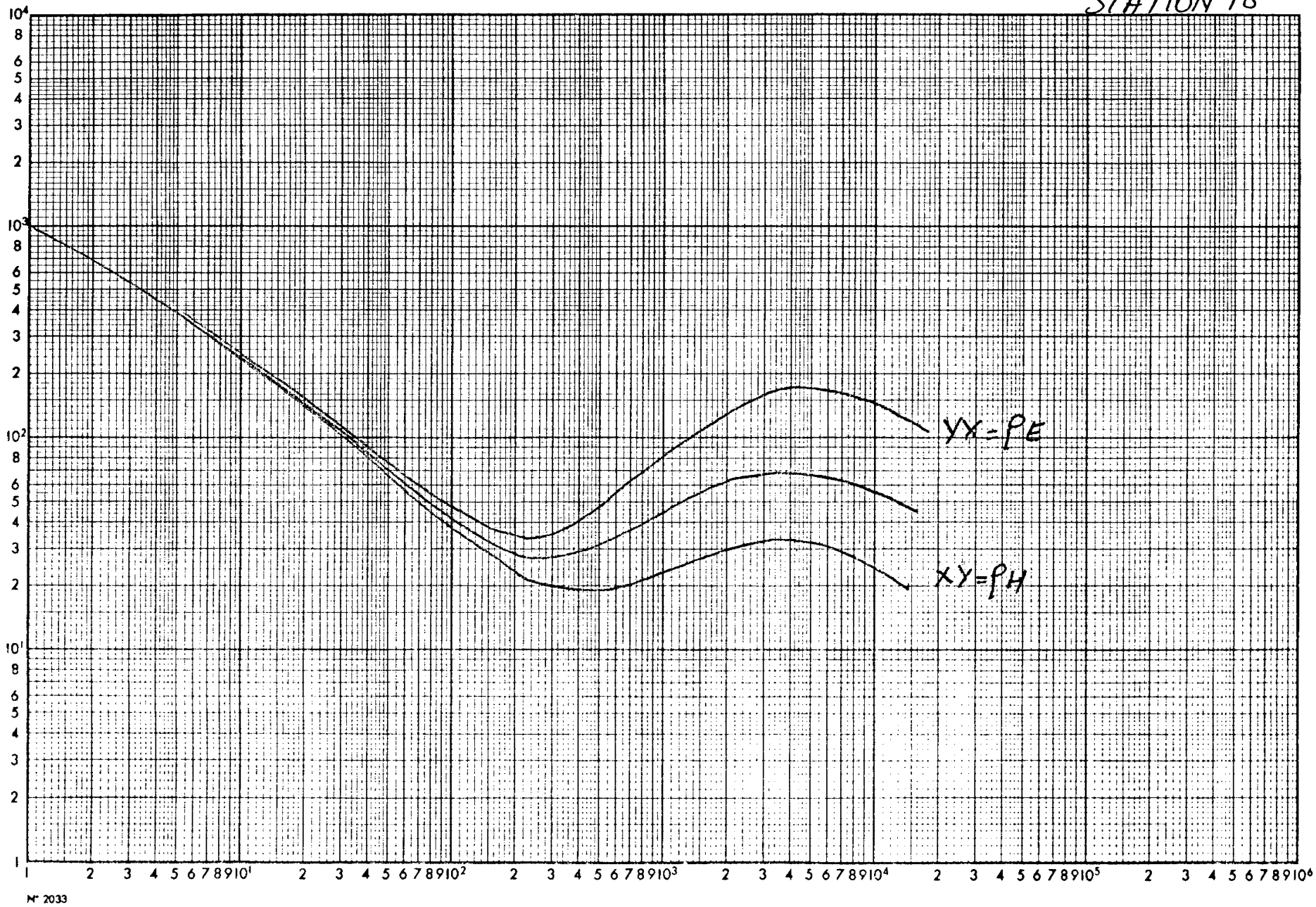

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | [illegible] | [illegible] | [illegible] | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | [illegible] | [illegible] | [illegible] | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' | |
| | | Sensibil. | 1 | 50mv/γ | 1 | 50mv/γ | 1 | | | |
| 18 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 19 | BF | Gain | 50 x 30 | 10 x 3 | 50 x 30 | 10 x 3 | 10 x 3 | | 108' | BON SIGNAL \| Ne pas TRAITER qui suivent les |
| | | Sensibil. | " | " | " | " | " | | | |
| 20 | MF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 7' | |
| | | Sensibil. | | | | | | | | |
| 21 | HF | Gain | 50 x 100 | 20 x 30 | 50 x 100 | 20 x 30 | 20 x 100 | | 1' | |
| | | Sensibil. | | | | | | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | Neige et Vent. |

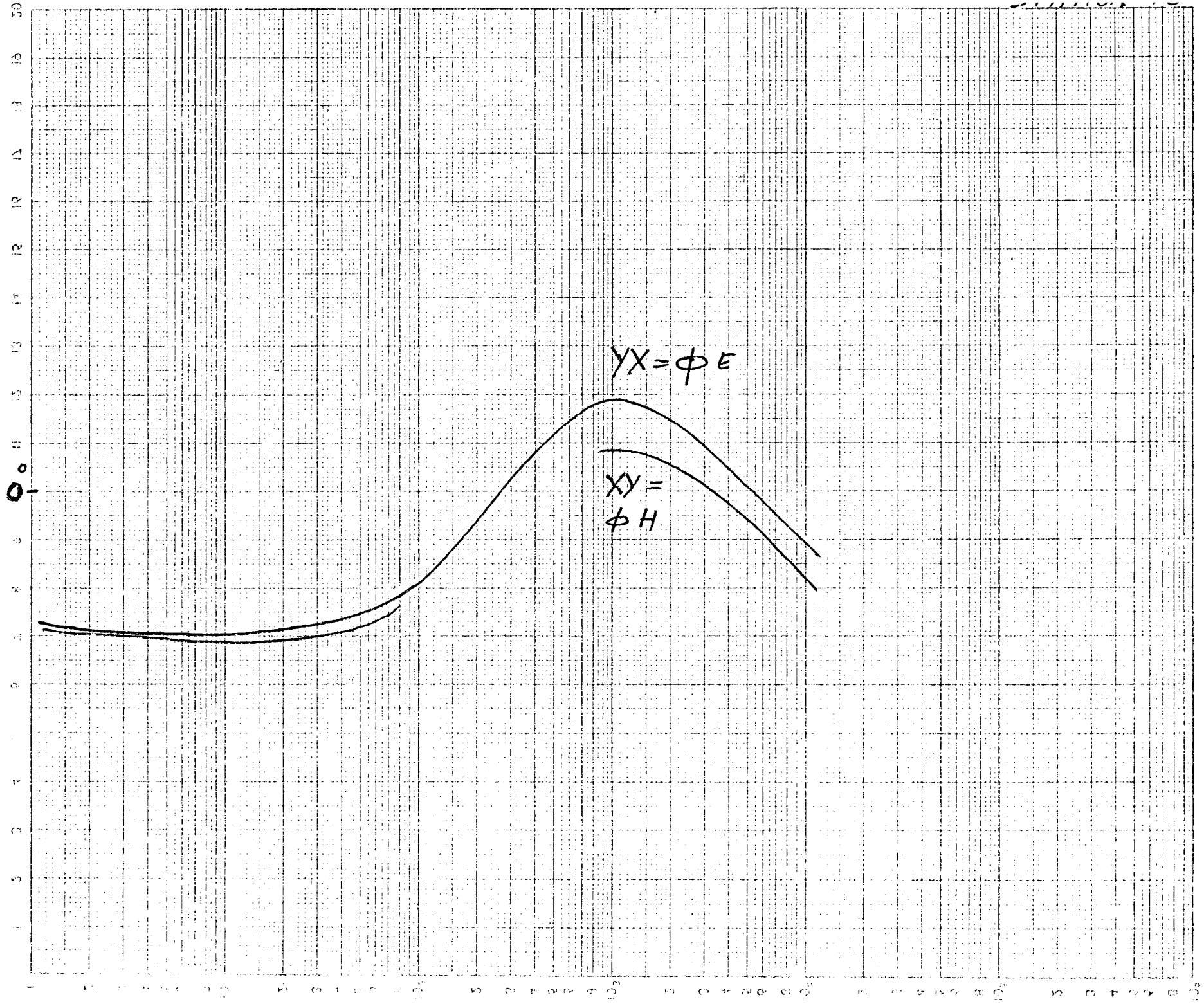
E.N.D.T FIN de BANDE 5.

• Forage pour Eau a 100m

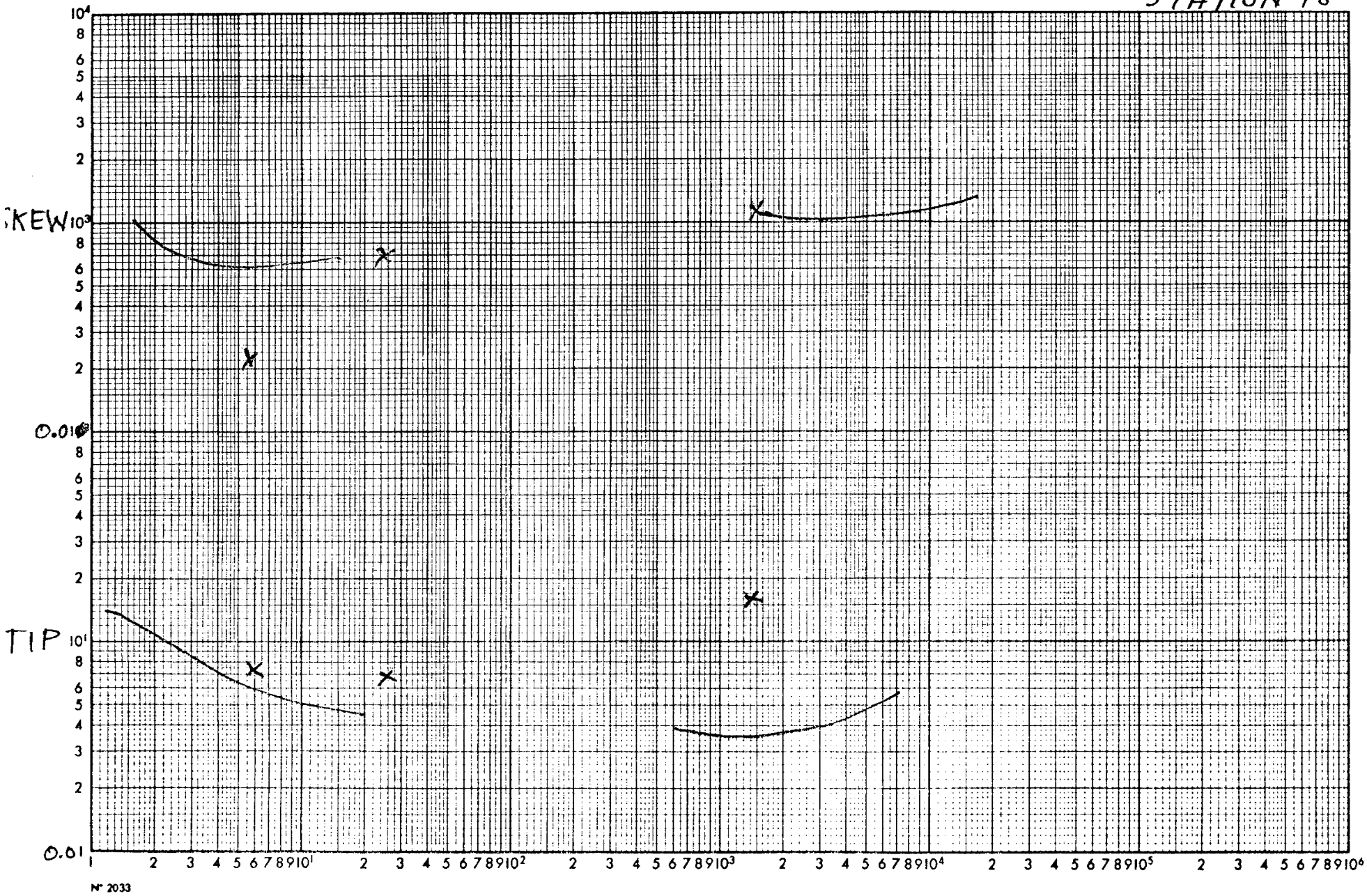
STATION 16




N° 2033


YX = ϕ E
XY = ϕ H
0°

STATION 16


SKEW
TIP
0.01
0.01
1 2 3 4 5 6 7 8 9 10¹ 2 3 4 5 6 7 8 9 10² 2 3 4 5 6 7 8 9 10³ 2 3 4 5 6 7 8 9 10⁴ 2 3 4 5 6 7 8 9 10⁵ 2 3 4 5 6 7 8 9 10⁶
N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 20.10.82 | 404 25 11 | GLASS MT. | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

• Ex = 485'

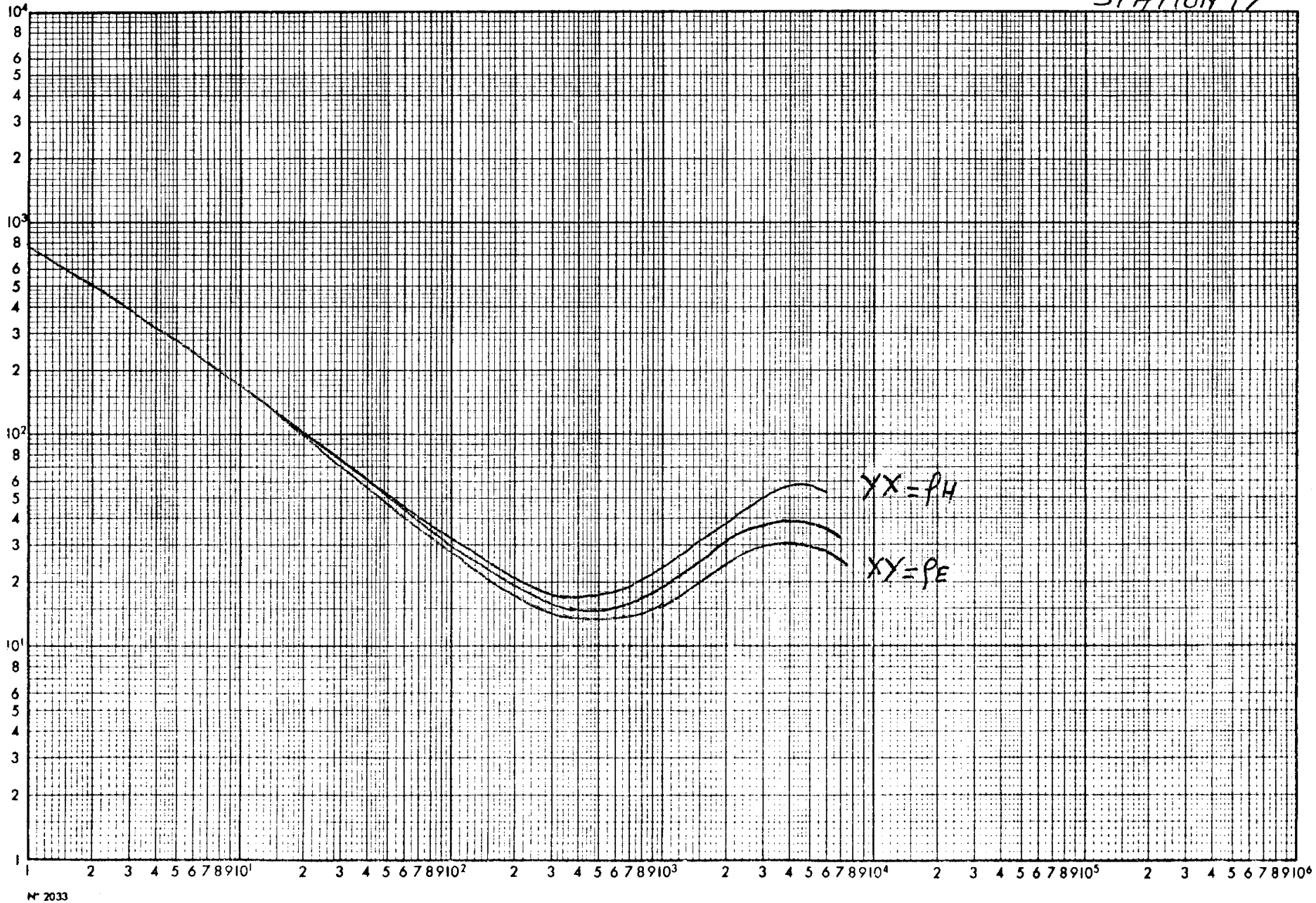
Station : 16

Tape : 3

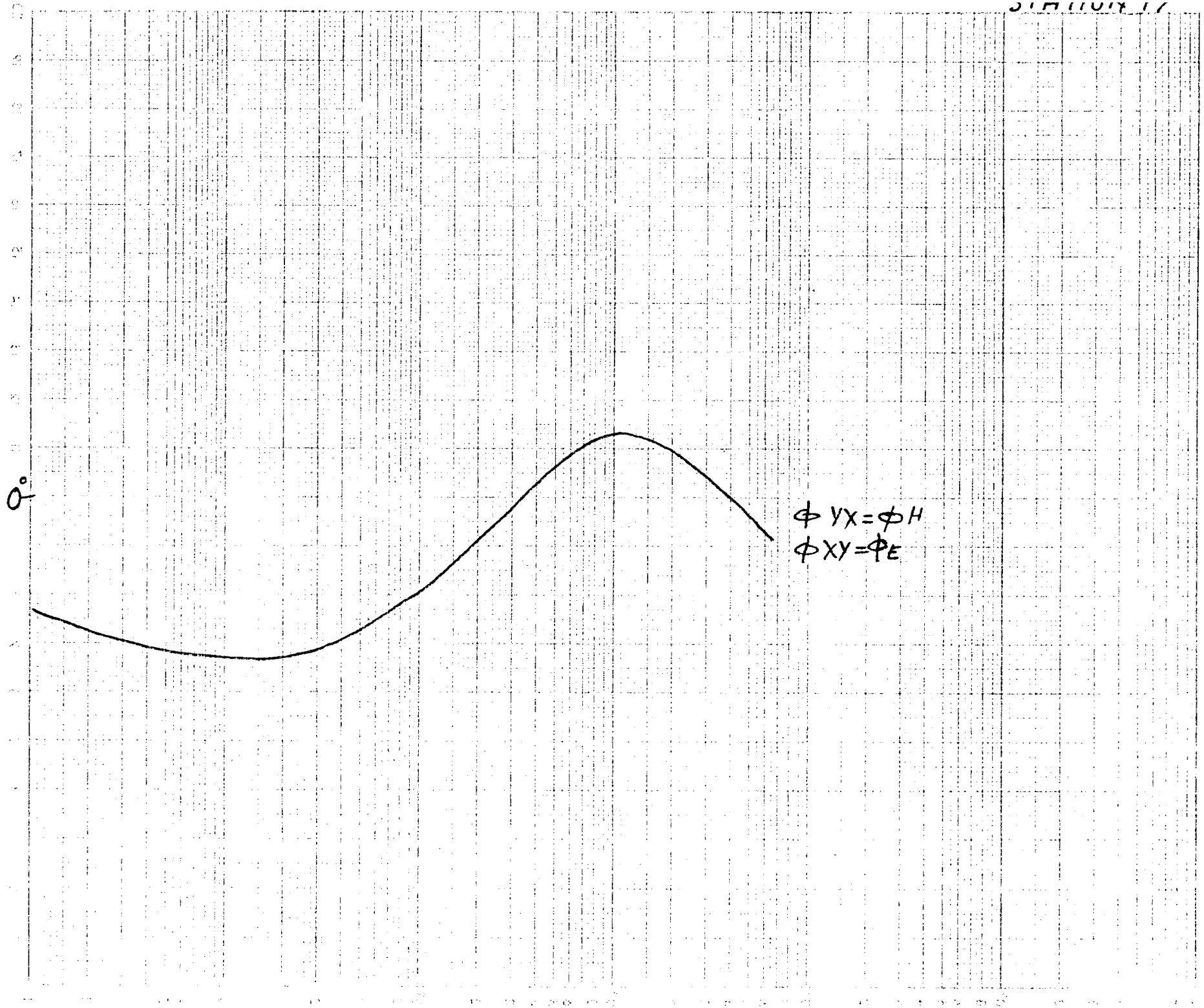
| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 485' | 5 kΩ | 140 gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 500' | 9 kΩ | 40 gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| L17 | MF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 7' | ⊗ |
| | | Sensibil. | 1 | 50mV/γ | 1 | 50mV/γ | 50mV/γ | | | |
| L18 | HF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| L19 | BF | Gain | 20x30 | 10x3 | 20x30 | 10x3 | 10x3 | | 107' | Bon SIGNAL - Mais beaucoup Petits "pets" à partir du mi des BF |
| | | Sensibil. | " | " | " | " | " | | | |
| 50 | MF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 7' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 51 | HF | Gain | 20x100 | 20x30 | 20x100 | 20x30 | 20x100 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| | | Gain | | | | | | | | |
| | | Sensibil. | | | | | | | | ciel couvert - pluie fine |

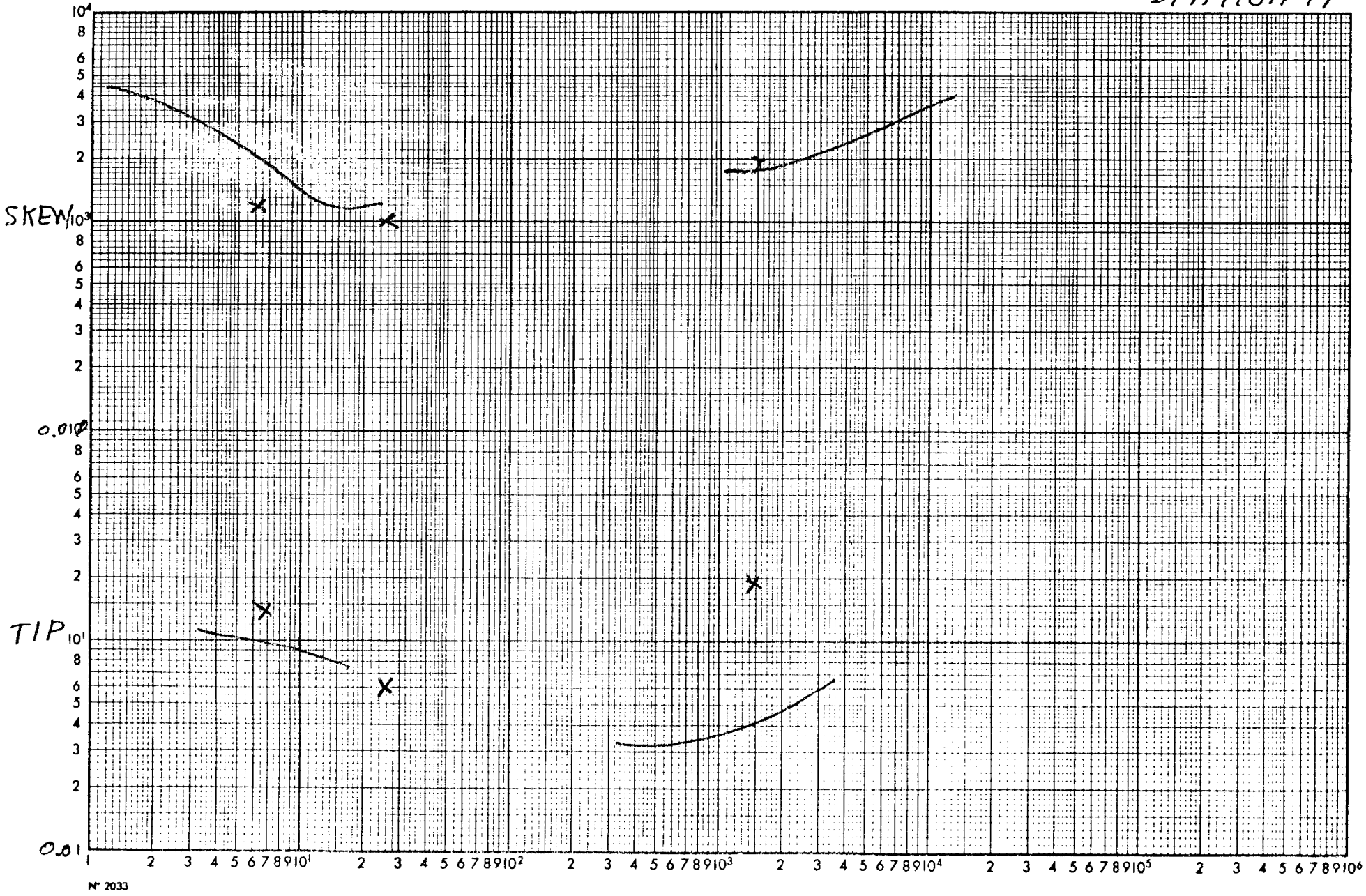
STATION 17




N° 2033


0°
φ YX = φ H
φ XY = φ E

STATION 17




N° 2033

| OBSERVER : | DATE : | SURVEY : | AREA : | CLIENT : |
|---|---|---|---|---|
| RAOULT | 20-10-82 | 404 25 11 | GLASS MT | UNION |

# MAGNETOTELLUR REPORT

Processing :

Sketch :

N

Station : 17

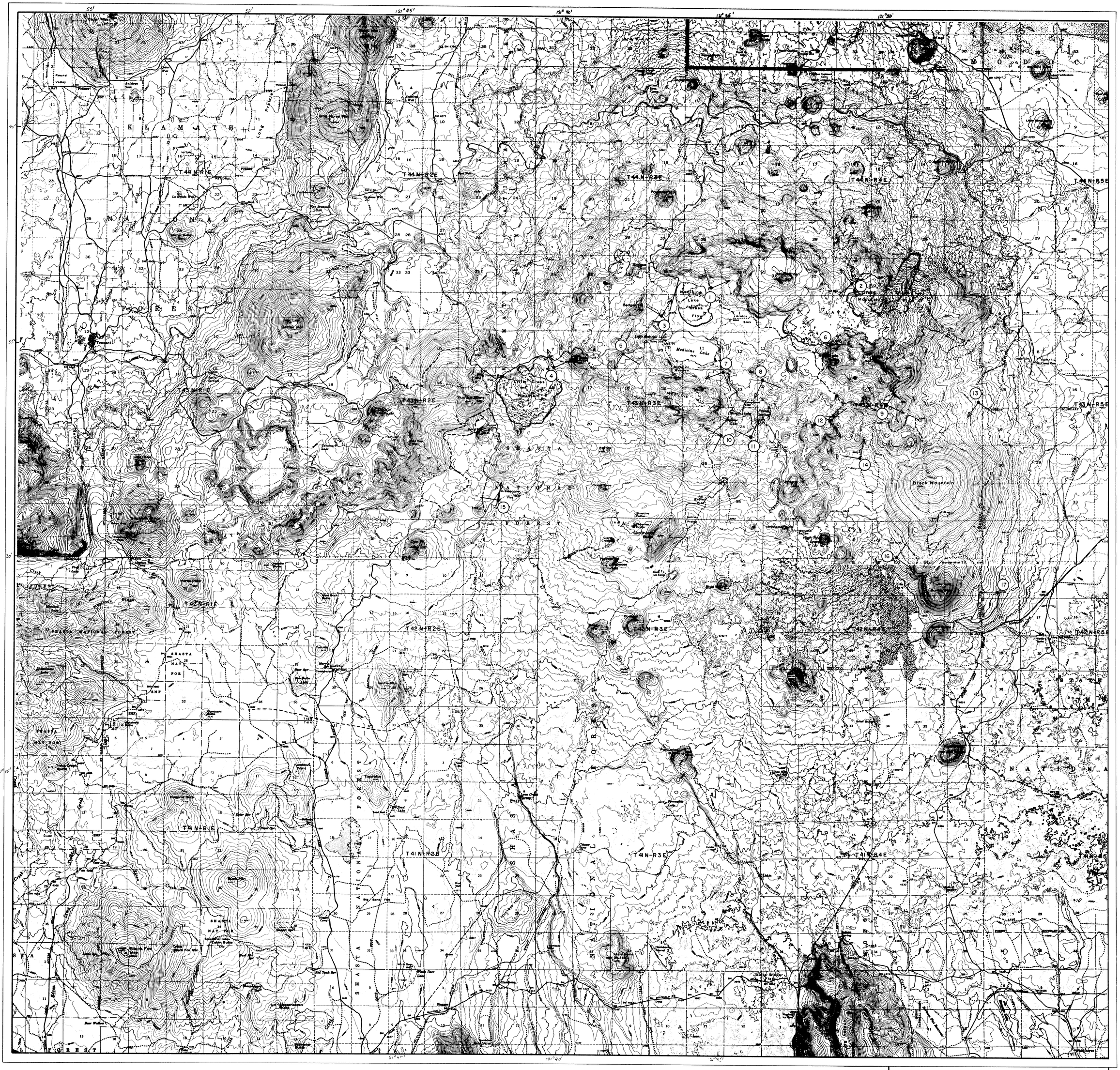
Tape : 3

+

- 800mV crête/crête de 60Hz à l'entrée de Ex
- 1800mV " " " de Ey
⇒ Gains plus faibles

| Channel | 1 | 2 | 3 | 4 | 5 | 6 | Length of the line | Resistance | Azimut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sensor | Ex | Hy | Ey | Hx | Hz | | 500' | 7kΩ | 300gr | Ex | | | Hx |
| Mag Number | | 11 | | 5 | 16 | | 480' | 8kΩ | 200gr | Ey | | | Hy |

| File | Domaine | | Channel 1 | Channel 2 | Channel 3 | Channel 4 | Channel 5 | Channel 6 | Time | Remarks : |
|---|---|---|---|---|---|---|---|---|---|---|
| 52 | MF | Gain | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 7' | |
| | | Sensibil. | 1 | 50mV/F | 1 | 50mV/F | 50mV/F | | | |
| 53 | HF | Gain | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 54 | BF | Gain | 10x30 | 10x3 | 5x30 | 10x3 | 10x3 | | 107' | Signal Moyen |
| | | Sensibil. | " | " | " | " | " | | | |
| 55 | MF | Gain | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 7' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 56 | HF | Gain | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 1' | |
| | | Sensibil. | " | " | " | " | " | | | |
| 57 | BF | Gain | 10x30 | 10x3 | 5x30 | 10x3 | 10x3 | | 70' | TRES BON SIGNAL |
| | | Sensibil. | " | " | " | " | " | | " | Ciel couvert |
| 58 | MF | | 10x30 | 10x100 | 5x30 | 10x30 | 10x30 | | 7' | ⊕ |





CGG

1475 LAWRENCE STREET
DENVER, COLORADO 80202
TELEPHONE (303) 825-2277


# UNION

## *GLASS MOUNTAIN PROSPECT*

## *SISKIYOU & MODOC COUNTIES, CALIFORNIA*

**MAGNETOTELLURIC SURVEY**

Ey
Ex
FIELD ARRAY
1 MT STATION

SCALE 1: 62,500

UCA07.3306